RQF LEVEL 3

CSACD301

COMPUTER SYSTEM AND ARCHITECTURE

Computer System Deployment

TRAINEE'S MANUAL

October, 2024

COMPUTER SYSTEM DEPLOYMENT

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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Under Rwanda TVET Board (RTB) guiding policies and directives

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COORDINATION TEAM

RWAMASIRABO Aimable

MARIA Bernadette M. Ramos

MUTIJIMA Asher Emmanuel

Production Team

Authoring and Review

MURWANASHYAKA Emmanuel

NISHIMIRWE Liliane

Validation

SHIMIRWAMUKIZA Raphaela

UWIKUNDA Idesbald

Conception, Adaptation and Editorial works

HATEGEKIMANA Olivier

GANZA Jean Francois Regis

HARELIMANA Wilson

NZABIRINDA Aimable

DUKUZIMANA Therese

NIYONKURU Sylvestre

KWIZERA INGABIRE Diane

Formatting, Graphics, Illustrations, and infographics

YEONWOO Choe

SUA Lim

SAEM Lee

SOYEON Kim

WONYEONG Jeong

HABIMANA Emmanuel

Financial and Technical support

KOICA through TQUM Project

TABLE OF CONTENT

ACRONYMS

AGP: Accelerated Graphics Port

AHCI: Advanced Host Controller Interface

ATX: Advanced Technology extended (motherboard form factor)

BIOS: Basic Input/output System

CMOS: Complementary Metal-Oxide-Semiconductor

CPU: Central Processing Unit

DIMM: Dual In-line Memory Module

DSL: Digital Subscriber Line

DVI: Digital Visual Interface

ECC: Error-Correcting Code (memory)

FAT: File Allocation Table

GPU: Graphics Processing Unit

HDD: Hard Disk Drive

HDMI: High-Definition Multimedia Interface

I/O: Input/output

IDE: Integrated Drive Electronics

IRQ: Interrupt Request

ITX: Information Technology extended

LAN: Local Area Network

LCD: Liquid Crystal Display

LED: Light Emitting Diode

LPT: Line Printer Terminal

MAC: Media Access Control (address)

MATX: Micro Advanced Technology extended

NIC: Network Interface Card

NTFS: New Technology File System

NV Me: Non-Volatile Memory Express

PATA: Parallel Advanced Technology Attachment

PCIe: Peripheral Component Interconnect Express

POST: Power-On Self-Test

PSU: Power Supply Unit

RAID: Redundant Array of Independent Disks

RAM: Random Access Memory

RJ45: Registered Jack 45 (network cable standard)

RPM: Revolutions per Minute (for HDDs)

RTB: Rwanda TVET Board

SATA: Serial Advanced Technology Attachment

SSD: Solid State Drive

TDP: Thermal Design Power

TPM: Trusted Platform Module

TQUM Project: TVET Quality Management Project

UEFI: Unified Extensible Firmware Interface

USB: Universal Serial Bus

VGA: Video Graphics Array

WAN: Wide Area Network

WLAN: Wireless Local Area Network

ZIF: Zero Insertion Force

INTRODUCTION

This trainee's manual includes all the knowledge and skills required in Computer System and Architecture specifically for the module of **"Computer System Deployment".** Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies. The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

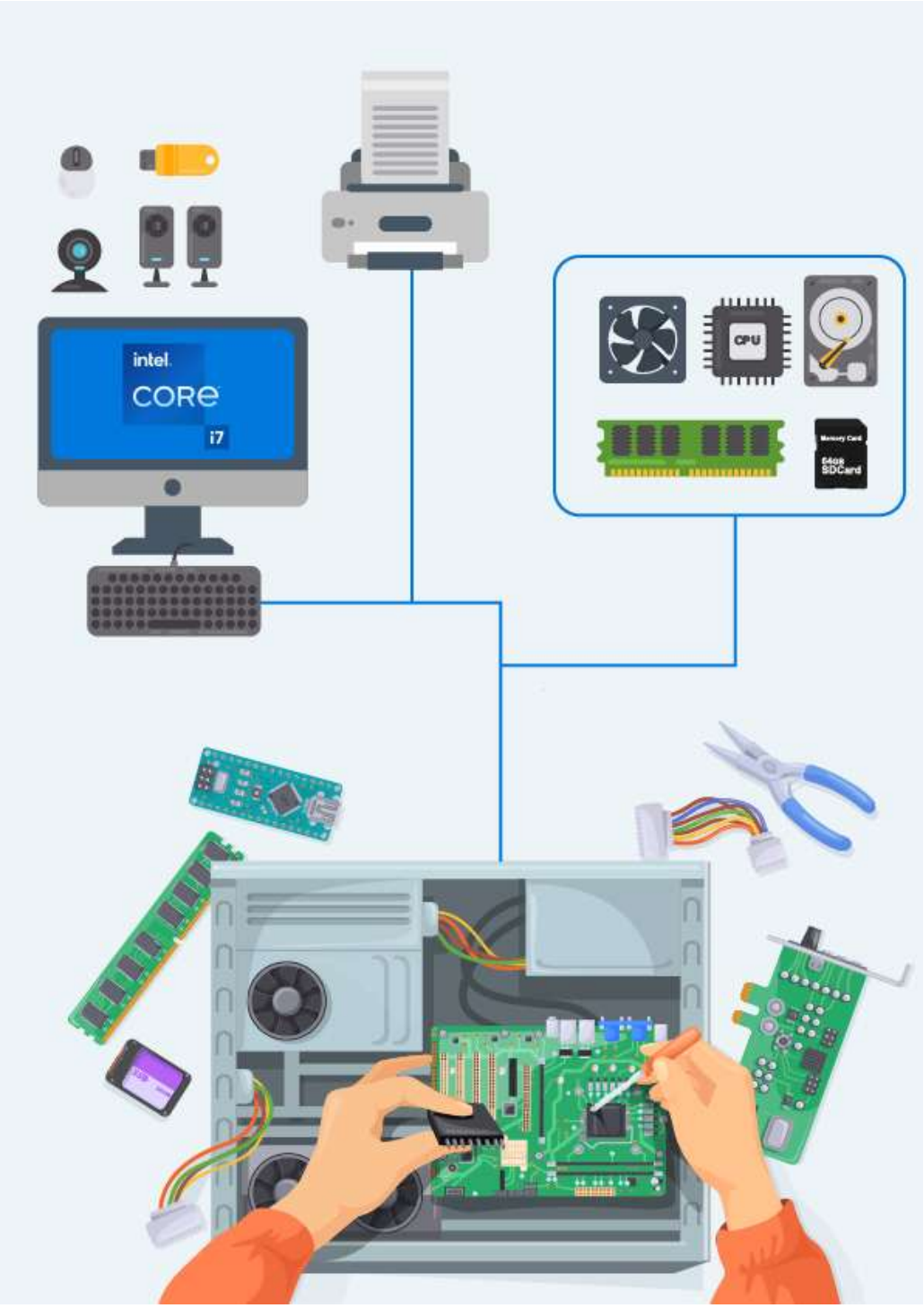
The trainee's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainee, you will start by addressing questions related to the activities, which are designed to foster critical thinking and guide you towards practical applications in the labour market. The manual also provides essential information, including learning hours, required materials, and key tasks to complete throughout the learning process.

All activities included in this training manual are designed to facilitate both individual and group work. After completing the activities, you will conduct a formative assessment, referred to as the end learning outcome assessment. Ensure that you thoroughly review the key readings and the 'Points to Remember' section.

MODULE CODE AND TITLE: CSACD301: COMPUTER SYSTEM DEPLOYMENT

Learning Outcome 1: Deploy computer system hardware
Learning Outcome 2: Install computer firmware
Learning Outcome 3: Deploy Operating system
Learning Outcome 4: Install application software


intel
CORE
i7
CPU
64GB
SDCard

Indicative contents

1.1. Introduction to computer hardware system deployment

1.2. Identification of main computer hardware components specifications

1.3. Connection of computer peripherals

1.4. Perform computer system hardware testing

Key Competencies for Learning Outcome 1: Deploy Computer Hardware System

Knowledge	Skills	Attitudes
• Definition of computer system deployment. • Identification of computer hardware system specification. • Description of Computer hardware system requirements. • Identification of computer peripheral devices. • Description of computer system hardware testing.	• Connecting computer hardware component and computer peripheral devices. • Configuring hardware component • Performing computer system hardware testing.	• Having Curiosity • Being Patience and Persistence. • Being Adaptability • Having Collaboration • Having Critical Thinking • Having Responsibility and Ownership

Duration: 15 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly computer hardware system based on system requirement
2. Identify properly computer parts based on computer system requirement
3. Connect effectively computer hardware parts based on user manual
4. Test effectively hardware system based on system requirement

Resources

Equipment	Tools	Materials
• PPEs • UPS • Computer • Projector • Scanner • Printer • Multimeter • Digital Camera	• Tool Kits	• Internet bundles • Electricity • Data cables • Cable ties

Indicative content 1.1: Introduction to computer hardware system deployment.

Duration: 3 hrs

Theoretical Activity 1.1.1: Introduction to computer hardware system deployment

Tasks:

1: You are asked to answer the following questions:

i. What is computer hardware system deployment?

ii. What are the main hardware parts of the computer?

2: Provide the answers for the asked questions and write them on flipchart/papers.

3: Present the findings/answers to the whole class.

4: For more clarification, read the **key readings 1.1.1**.

5: In addition, ask questions where necessary.

Key readings 1.1.1: Introduction to computer hardware system deployment

Computer: is an electronic device that operates (works) under the control of programs stored in its own memory unit.

Also it can be defined as An electronic device that accepts data as input, and transforms it under the influence of a set of special instructions called Programs, to produce the desired output (referred to as Information).

A computer is described as an electronic device because; it is made up of electronic components and uses electric energy (such as electricity) to operate.

A computer has an internal memory, which stores data & instructions temporarily awaiting processing, and even holds the intermediate result (information) before it is communicated to the recipients through the Output devices.

It works on the data using the instructions issued, means that, the computer cannot do any useful job on its own. It can only work as per the set of instructions issued. A computer will accept data in one form and produce it in another form. The data is normally held within the computer as it is being processed.

1. **Computer hardware system deployment** refers to the process of setting up and installing the physical components and systems of a computer or network to ensure they function correctly and efficiently in a specific environment**.**

Computer System: Is a collection of entities (hardware, software and livewire) that are designed to receive, process, manage and present information in a meaningful format.

Computer hardware: Are physical parts/ intangible parts of a computer.

Eg: Input devices, output devices, central processing unit and storage devices also known as to the physical, tangible computer equipment and devices, which provide support for major functions such as input, processing (internal storage, computation and control), output, secondary storage (for data and programs), and communication.

Computer software: also known as programs or applications. They are classified into two classes namely - system software and application software

2. **Main hardware parts of computer:**

- Central Processing Unit (CPU)
- Motherboard
- Random Access Memory (RAM)
- Hard Drive/SSD (Solid State Drive)
- Power Supply Unit (PSU)
- Input Devices
- Output Devices

2.1.The Brain: Central Processing Unit (CPU)

Often referred to as the "brain" of the computer, the CPU is responsible for executing instructions and performing calculations. Think of it as the command center that processes data and controls the overall operations of the computer.

2.2.The Backbone: Motherboard

The motherboard is the main circuit board that connects and controls all the other components of a computer. It's like the central hub that ensures all parts communicate efficiently. It houses the CPU, RAM, and other essential components.

2.3.Random Access Memory (RAM) Short-Term Memory

RAM is the computer's temporary storage space. It holds data and instructions that the CPU is actively using. It's like a scratchpad where the computer got down notes for immediate use. Once the computer is turned off, the data in RAM is lost.

2.4.Hard Drive/Solid State Drive (SSD) Long-Term Storage:

These devices store data permanently, even when the computer is turned off.

Hard Drive: Traditionally used, it stores data on magnetic disks.
SSD: A newer technology that uses flash memory, offering faster read and write speeds.

2.5.Power Supply Unit (PSU)

The Powerhouse: Power Supply Unit (PSU)
The PSU converts electrical power from the wall outlet into a usable format for the computer's components. It's essentially the computer's power source.

2.6.Input Devices: (Getting Information In)

Input devices allow users to interact with the computer and provide data.

Examples include:

Keyboard: For typing text
Mouse: For navigating and clicking
Scanner: For converting physical documents into digital format
Webcam: For capturing images and videos

2.7.Output Devices: (Getting Information Out)

Output devices display or produce information processed by the computer.

Examples include:

Monitor: Visual display of information
Printer: Produces physical copies of documents
Speakers: Output audio
Projector: Displays images on a large screen

Points to Remember

- **Computer hardware system deployment** refers to the process of setting up and installing the physical components and systems of a computer or network to ensure they function correctly and efficiently in a specific environment**.**
- **Main hardware parts of computer:** Central Processing Unit (CPU), Motherboard, Random Access Memory (RAM), Hard Drive/SSD (Solid State Drive), Power Supply Unit (PSU), Input Devices, Output Devices.

Application of learning 1.1.

Suppose you are requested to buy a computer for a company that sell air ticket in your country, what are the main hardware parts of a computer you can focus on, so that that computer will be able to serve that tickets creation for that company.

Indicative content 1.2: Identification of main computer hardware components specifications

Duration: 5 hrs

Theoretical Activity 1.2.1: Identification of main computer hardware components specifications

Tasks:

1: Answer the following question.

i. Differentiate computer input and output unit?
ii. What is processing unit?
iii. Identify the computer chipset with their features?
iv. Differentiate primary memory from secondary memory of computer?
v. What are the hardware components specification?

2: Provide the answers for the asked questions and write them on flipchart/papers.

3: Present your findings to the trainer or your colleagues.

4: Ask them to read the **Key readings 1.2.1** in their manuals.

Key readings 1.2.1.: Identification of main computer hardware components specifications

There are five main Computer Hardware Components specification:

Input unit

Processing unit

Chipset

memory

Output unit

1. **Input Unit**

The input unit, also known as the input device or input hardware, is a crucial component of a computer system responsible for receiving and translating user commands and data into a form

that the computer can process. It acts as the interface between the user and the computer, allowing users to interact with and control the system.

1.1. Function of the Input unit

Data Entry: Converts user actions and input into digital data that the computer can understand.

Command Input: Allows users to provide commands to control software and hardware functions.

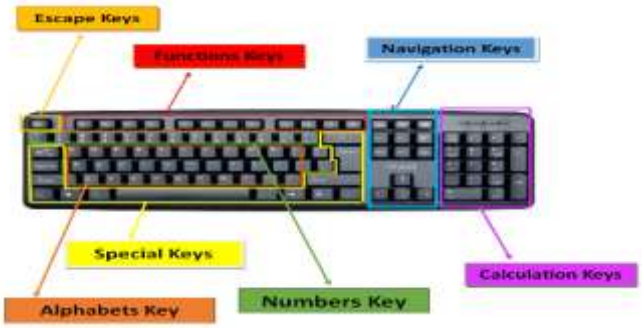
Interaction: Facilitates user interaction with various applications and systems.

1.2. Types of input devices

1.2.1. Keyboard

Function: Allows users to input text, numbers, and commands by pressing keys.

Specifications: Key layout, type of switches (mechanical, membrane), additional features like backlighting or programmable keys.



Layout: Refers to the arrangement of keys.

Example:

QWERTY: The standard layout in most English-speaking countries.

Ten keyless (TKL): A smaller version of a keyboard without the number pad.

1.2.2. Mouse

Function: A pointing device that allows users to interact with the graphical user interface (GUI) by moving a cursor on the screen and clicking objects.

Specifications: Sensitivity (DPI), type (optical, laser), number of buttons, scroll wheel functionality.

Type of mouse:

Optical Mouse: Uses a light sensor to detect movement on a surface. Most modern mice are optical.

Laser Mouse: Uses a laser for more precise tracking, especially on smooth or reflective surfaces.

Trackball Mouse: Uses a ball that the user rotates to move the cursor, offering precision for specific tasks like design or editing.

Connectivity:

Wired: Connects via USB for a direct, stable connection without the need for batteries.

Wireless: Connects via Bluetooth or a wireless dongle, offering more mobility.

1.2.3.Touchpad

Function: A touch-sensitive surface that serves as a pointing device, commonly found on laptops.

Specifications: Size, gesture support, pressure sensitivity.

1.2.4.Scanner

Function: Converts physical documents and images into digital format.

Specifications: Resolution (DPI), colour depth, scanning speed.

1.2.5.Microphone

Function: Captures audio input and converts it into digital signals for processing by the computer.

Specifications: Type (dynamic, condenser), sensitivity, frequency response.

1.2.6.Webcam

Function: Captures video and images and inputs them into the computer for communication and recording purposes.

Specifications: Resolution, frame rate, field of view.

1.2.7. Game Controller

Function: Provides input for gaming applications through buttons, joysticks, and motion sensors.

Specifications: Button layout, analog sticks, vibration feedback.

1.2.8. Digital Pen/Tablet

Function: Allows for precise input on a digital surface, often used for graphic design and note-taking.

Specifications: Pressure sensitivity, resolution, tilt support.

1.2.9.Barcode Scanner

Function: Reads barcodes and converts them into digital data for inventory management and other applications.

Specifications: Type (laser, CCD), scanning range, data processing speed.

2. Processing unit

The processing unit, commonly known as the Central Processing Unit (CPU), is the core component of a computer system responsible for executing instructions and performing calculations that drive the computer's operations. It acts as the brain of the computer, processing data and managing tasks.

2.1.Key Functions of the CPU

2.1.1. Instruction Execution:

Fetch: Retrieves instructions from the computer's memory.

Decode: Interprets the fetched instructions to understand the required operation.

Execute: Performs the operations specified by the instructions, such as calculations or data manipulation.

Store: Writes the results of operations back to memory.

2.1.2.Control Unit:

Directs the operation of the processor and coordinates the activities of other hardware components.

Manages the flow of data between the CPU, memory, and input/output devices.

2.1.3.Arithmetic Logic Unit (ALU):

Performs arithmetic operations (addition, subtraction) and logical operations (comparisons, bitwise operations).

Executes the fundamental operations required for most computational tasks.

2.1.4.Registers:

Small, fast storage locations within the CPU used to hold data and instructions temporarily during processing.

Includes general-purpose registers, index registers, and special-purpose registers like the Program Counter (PC) and Accumulator (ACC).

2.2.Types of CPUs

2.2.1.Desktop CPUs:

Characteristics: Higher performance and power consumption; used in desktops and workstations.

Speed (GHz): Measured in gigahertz (GHz), this defines how fast the CPU can process data.

Example: A CPU with a speed of 3.8 GHz can perform 3.8 billion cycles per second.

Cores: The number of independent units in a CPU that can execute tasks.

Example: A CPU with 8 cores can handle 8 tasks simultaneously, improving multitasking performance.

Examples: Intel Core i5/i7/i9, AMD Ryzen 5/7/9.

2.2.2.Mobile CPUs:

Characteristics: Designed for laptops, tablets, and smartphones with a focus on power efficiency and thermal management.

Examples: Intel Core i5/i7/i9 (mobile versions), ARM-based processors.

2.2.3.Server CPUs:

Characteristics: Optimized for high performance, reliability, and scalability in server environments.

Examples: Intel Xeon, AMD EPYC.

3. Chipset

3.1. Definition: A chipset is a collection of integrated circuits (ICs) designed to work together to control data traffic between the processor and other components of the computer.

A chipset is a crucial component of a computer's motherboard that manages data flow between the CPU, memory, storage, and peripheral devices. It acts as the communication hub, facilitating interactions between the various parts of a computer system

It serves as the central controller for the data paths, ensuring that data moves efficiently between the CPU, RAM, storage devices, and other peripherals.

Chipset: Determines the motherboard's compatibility with CPUs, RAM, and other components. It manages data flow between the processor, memory, and peripherals.

Example: Intel Z790 or AMD B550 chipsets. Higher-end chipsets allow for features like overclocking and multiple GPU setups.

3.2.Main Types of chipset

3.2.1.Northbridge:

Function: Traditionally managed high-speed communication between the CPU, RAM, and high-performance peripherals like the graphics card.

Characteristics: Connected directly to the CPU and memory, handling tasks that require fast data transfer rates.

3.2.2. Southbridge:

Function: Managed slower communication between the CPU and lower-speed peripherals, such as storage devices (HDDs, SSDs), USB ports, and on board audio.

Characteristics: Connected to the Northbridge and responsible for handling tasks that do not require high-speed data transfer.

There is other types of chipset:

Server Chipsets: Optimized for data centers and enterprise environments, focusing on high reliability, multiple CPU support, and advanced memory handling.

Embedded Chipsets: Used in specialized devices like industrial machines, medical equipment, and IoT devices. These chipsets are designed for specific tasks with low power consumption and high reliability.

Difference between Northbridge and Southbridge

Definition

A Northbridge is a chip in the core logic chipset architecture on the northern section of the PC motherboard.

A Southbridge is a chip in the core logic chipset architecture on the southern section of the PC motherboard. This is the basic difference between Northbridge and Southbridge.

Location

As their names indicate, Northbridge is located in the northern section of the motherboard while Southbridge is located in the southern section of the motherboard.

Connection to CPU

The main difference between Northbridge and Southbridge is in the connection to the CPU.

While Northbridge is directly connected to the CPU,

Southbridge connects to the CPU via the Northbridge.

Connecting Components

Northbridge connects to the CPU, RAM, AGP, PCI Express slots and Southbridge. On the other hand, Southbridge connects to the PCI bus slots, BIOS, SATA and IDE connectors, USB ports and Northbridge.

Operating Speed

Moreover, Northbridge operates faster than Southbridge. The difference between Northbridge and Southbridge is that Northbridge is a chip in the chipset of a motherboard that directly connects to the CPU while Southbridge is a chip in the chipset of a motherboard that does not directly connect to the CPU. In brief, Northbridge connects to faster components and Southbridge connects to the slower components.

3.3.Functions of a Chipset

3.3.1.Data Management:

Memory Control: Manages the flow of data between the CPU and RAM.

Peripheral Control: Manages communication between the CPU and peripheral devices such as hard drives, USB ports, and network interfaces.

3.3.2.Expansion:

PCI/PCIe Slots: Controls the expansion slots for adding additional components like graphics cards, network cards, and storage controllers.

I/O Ports: Manages input and output ports for connecting external devices like keyboards, mice, printers, and monitors.

3.3.3.Performance Optimization:

Overclocking: Some chipsets support overclocking features, allowing users to increase the performance of their CPU and memory beyond standard specifications.

Power Management: Optimizes power consumption and thermal management to ensure efficient operation of the system.

3.3.4. Connectivity:

Storage Interfaces: Manages interfaces like SATA and NV Me for connecting storage devices.

Networking: Controls integrated network interfaces, such as Ethernet ports and sometimes wireless interfaces.

3.3.5.Multimedia:

Integrated Audio: Provides built-in audio capabilities for sound processing.

Integrated Graphics: Some chipsets include integrated graphics capabilities, reducing the need for a separate GPU for basic display tasks.

Factor to consider when choosing a Chipset:

Compatibility: Ensure the chipset is compatible with the chosen CPU, memory, and other components.

Features: Consider the features required, such as support for high-speed interfaces, overclocking capabilities, and specific peripheral connections.

Performance: Higher-end chipsets often provide better performance and more advanced features, but may come at a higher cost.

4. Memory

Memory: is the electronic holding place for the instructions and data a computer needs to reach quickly. It's where information is stored for immediate use. Memory is one of the basic functions of a computer, because without it, a computer would not be able to function properly. Memory is also used by a computer's operating system, hardware and software.

There are technically two types of computer memory:

Primary and

Secondary.

The term memory is used as a synonym for primary memory or as an abbreviation for a specific type of primary memory called random access memory (RAM). This type of memory is located on microchips that are physically close to a computer's microprocessor.

If a computer's central processer (CPU) had to only use a secondary storage device, computers would become much slower. In general, the more memory (primary memory) a computing device has, the less frequently the computer must access instructions and data from slower (secondary) forms of storage.

Description of computer memory

Cache Memory

Primary Memory/Main Memory

Secondary Memory

4.1.Cache memory

Is a very high speed semiconductor memory which can speed up the CPU.

It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU. The parts of data and programs are transferred from the disk to cache memory by the operating system, from where the CPU can access them.

At its core, cache memory is a form of random access memory (RAM) that stores recently accessed data for quick retrieval. It sits between the main RAM and the CPU, acting as an intermediary for faster data access. As more data is stored in the cache, less time needs to be spent accessing information from RAM

The advantages of cache memory are as follows :

• Cache memory is faster than main memory.

• It consumes less access time as compared to main memory.

• It stores the program that can be executed within a short period of time.

• It stores data for temporary use. Disadvantages

The disadvantages of cache memory are as follows :

• Cache memory has limited capacity.

• It is very expensive.

4.2.Primary memory (main memory)

Primary memory holds only those data and instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers.

The data and instruction required to be processed resides in the main memory.

It is divided into two subcategories RAM and ROM.

RAM (Random Access Memory) is the internal memory of the CPU for storing data, program, and program result. It is a read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address, that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time. Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence, a backup Uninterruptible Power System (UPS) is often used with computers. RAM is small, both in terms of its physical size and in the amount of data it can hold.

Size: The amount of memory available, usually measured in gigabytes (GB).

Example: 16GB of RAM is common for gaming and general productivity, while 32GB is often used for professional video editing or 3D rendering.

Speed: Measured in MHz or MT/s (mega transfers per second), it determines how fast data moves to and from RAM.

Example: 3200MHz DDR4 RAM is faster than 2133MHz DDR4 RAM

RAM have of two types :

• Static RAM (SRAM)

• Dynamic RAM (DRAM)

Characteristics of primary Memory

- These are semiconductor memories.
- It is known as the main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is the working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without the primary memory.

4.3. Secondary memory

This type of memory is also known as external memory or non-volatile. It is slower than the main memory.

These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, Hard disk, CD-ROM, DVD, etc.

Hard Disk

The **hard disk drive (HDD)** is a type of storage device that uses spinning disks (platters) to read and write data. Though HDDs have been largely replaced by SSDs for performance, they are still used for large storage needs due to their lower cost per gigabyte.

Capacity: The amount of storage space available, typically measured in gigabytes (GB) or terabytes (TB).

Example: A 4TB HDD can store a large amount of data but is slower compared to SSDs.

Type: Hard drives can differ in technology and design.

Standard HDD: Uses spinning magnetic platters and a mechanical arm to read/write data. Commonly used in desktop computers for large storage needs.

SSHD (Solid State Hybrid Drive): Combines a small amount of SSD storage with a traditional HDD, providing faster data access for frequently used files.

Speed:

RPM (Revolutions Per Minute): The speed at which the platters spin, affecting how quickly data can be read or written.

Example: A 7200 RPM drive is faster than a 5400 RPM drive.

Data Transfer Rate: Measured in megabytes per second (MB/s). HDDs typically have slower transfer rates compared to SSDs.

Example: An HDD might have a transfer rate of 150MB/s, while an SSD can reach 500MB/s or higher.

Characteristics of Secondary Memory

- These are magnetic and optical memories.
- It is known as the backup memory.
- It is a non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without the secondary memory.
- Slower than primary memories.

Memory vs. storage

The term *storage* refers to secondary memory and is where data in a computer is kept. An example of storage is a hard drive or a hard disk drive (HDD). Storage is non-volatile, meaning the information is still there after the computer is turned off and then back on. A running

program may be in a computer's primary memory when in use -- for fast retrieval of information -- but when that program is closed, it resides in secondary memory or storage.

How much space is available in memory and storage differs as well. In general, a computer will have more storage space than memory. For example, a laptop may have 8 GB of RAM while having 250 GB of storage. The difference in space is there because a computer will not need fast access to all the information stored on it at once, so allocating approximately 8 GB of space to run programs will suffice.

The terms *memory* and *storage* can be confusing because their usage today is not always consistent. For example, RAM can be referred to as primary storage -- and types of secondary storage can include flash memory. To avoid confusion, it can be easier to talk about memory in terms of whether it is volatile or non-volatile -- and storage in terms of whether it is primary or secondary.

5. Output Unit

The output unit, also known as output devices or output hardware, is responsible for presenting data and information processed by the computer to the user or to other systems. It translates digital signals from the computer into a form that is understandable and usable by humans or other devices.

5.1.Functions of the Output Unit

Data Presentation:

Purpose: Converts processed information into human-readable or interpretable forms, such as text, images, audio, or video.

Output Can be visual (e.g., monitors), auditory (e.g., speakers), or tactile (e.g., printers).

Communication:

Purpose: Facilitates interaction with external devices or systems, allowing users to receive feedback and results from their inputs or commands.

5.2.Types of Output Devices

5.2.1.Monitors (Displays):

Function: Visual output device that presents graphical user interfaces, videos, and text.

Types of monitor

LCD (Liquid Crystal Display): Common for its slim profile and energy efficiency.

LED (Light Emitting Diode): A type of LCD that uses LED backlighting for improved brightness and colour accuracy.

OLED (Organic Light Emitting Diode): Offers superior colour accuracy and contrast, with each pixel emitting its own light.

Monitor's specifications

Resolution: Determines the clarity and detail of the image (e.g., 1080p, 4K).

Screen Size: Measured diagonally, affects the viewing area.

Refresh Rate: The number of times per second the display refreshes, impacting motion smoothness (e.g., 60Hz, 144Hz).

5.2.2.Printers:

Function: Produces physical copies of digital documents and images on paper or other media.

Types of printers:

Inkjet Printers: Uses liquid ink to produce high-quality colour prints.

Laser Printers: Uses toner and a laser beam to produce sharp, fast black-and-white or colour prints.

Dot Matrix Printers: Uses a matrix of pins to create characters and images, often used for multi-part forms.

Printer's specifications:

Print Resolution: Measured in DPI (dots per inch), affects print quality.

Print Speed: Measured in pages per minute (PPM), affects how quickly documents are produced.

5.2.3.Speakers:

Function: Outputs audio from the computer, including music, voice, and sound effects.

Types of speakers:

External Speakers: Connected via audio jacks or Bluetooth for high-quality sound output.

Built-in Speakers: Integrated into monitors or laptops, providing basic audio functionality.

Speaker's specifications:

Power Output: Measured in watts, determines the volume and clarity of sound.

Frequency Response: Range of audio frequencies the speakers can produce.

5.2.4.Headphones:

Function: Personal audio output device for listening to sound privately.

Types of head phones:

1. Over-Ear: Covers the entire ear, providing immersive sound.

2. On-Ear: Sits on the ear, typically more compact.

3. n-Ear: Fits directly into the ear canal, offering high portability.

Headphone's specifications:

Impedance: Resistance to electrical current, affecting compatibility with different audio sources.

Frequency Response: Range of sound frequencies the headphones can reproduce.

5.2.5.Projectors:

Function: Displays visual output on a larger screen or surface, used for presentations, movies, and large-scale displays.

Types of projectors:

DLP (Digital Light Processing): Uses a digital micro mirror device for sharp images.

LCD (Liquid Crystal Display): Uses liquid crystals to produce bright, clear images.

LCoS (Liquid Crystal on Silicon): Combines liquid crystal and silicon for high-resolution displays.

Projector's specifications:

Brightness: Measured in lumens, affects how visible the image is in different lighting conditions.

Resolution: Determines the detail of the projected image (e.g., 1080p, 4K).

5.2.6.Plotters:

Function: Produces large-scale graphics and drawings, commonly used in engineering and architectural fields.

Types of plotters:

Pen Plotters: Use pens to draw precise lines and shapes.

Cutting Plotters: Cut shapes out of various materials for applications like sign-making.

Choosing an Output Device consider the following:

Compatibility: Ensure the device is compatible with the computer's ports and software.

Performance: Consider specifications like resolution, print speed, or audio quality based on the intended use.

Budget: Determine how much to spend based on features and performance needs.

Difference between Input and Output Devices	
Input devices	**Output devices**
Accept computer's data	Reflect computer's data
The computer users command them	The computer processor command them
Conversion of human-friendly signals into a machine-friendly language	Conversion of machine-friendly language to user friendly language
Send signals to the CPU for execution	Send processed signals to the computer user
Assist computer system in receiving data	Assist computer system in displaying data
It is complex in designing comparatively	It is lesser complex in design
Examples: keyboard, scanner, Mousse etc.	Example: Monitor, Printers, Speakers etc.

Points to Remember

- The **Input Unit** captures and translates user commands for the computer.
- The **Processing Unit (CPU)** executes instructions and calculations.
- The **Chipset** manages data flow between key components.
- **Memory** stores data for quick access
- The **Output Unit** presents processed data to the user.

Application of learning 1.2.

As a technician tasked with purchasing a computer for a company, identifying the main hardware components and their specifications is crucial to ensure the system meets the company's needs.

Indicative content 1.3: Connection of computer peripherals

Duration: 4 hrs

Theoretical Activity 1.3.1: Identification of computer peripherals

Tasks:

1. You are asked to answer the following question
    i. Identify computer peripherals.
    ii. Differentiate ports from connectors? And Give the examples for each?
    iii. Differentiate power connection and Data connection.
2. Provide the answers for the asked questions and write them on flipchart/papers.
3. Present the findings/answers to the whole class.
4. Give the expert view to them
4. For more clarification, read the **key readings 1.3.1**.
5. In addition, ask questions where necessary.

Key readings 1.3.1.: Identification of computer peripherals

1. Definition

A computer peripheral or peripheral device is an auxiliary device used to put information into and get information out of a computer. The term peripheral device refers to all hardware components that are attached to a computer and are controlled by the computer system.

2. Types of Peripherals

Input peripheral devices: Keyboard, Computer mouse, Graphic tablet, Touchscreen, Barcode reader, Image scanner, Microphone, Webcam, Game controller, Light pen, Scanner, Digital camera.

Output peripheral devices: Computer display, Printer, Projector, Speaker.

Storage peripheral devices: Floppy disk drive, Flash drive, Disk drive, Smartphone or Tablet computer storage interface, CD/DVD drive.

Input/ Output peripherals devices: Modem, Network interface controller (NIC).

2.1.Input Peripherals Devices:

These devices allow you to input data into the computer.

Keyboard: Used in typing text, numbers, and commands.

Mouse: is used in navigating the computer's interface.

Scanner: it is for converting physical documents into digital images.

Microphone: it is used in recording and capturing audio input.

Webcam: it is used capturing video and images.

Game controllers: Used in playing video games.

Touchscreen: For interacting directly with the computer's display.

2.2.Output peripheral Devices:

These devices display or produce information processed by the computer.

Monitor: For displaying visual output.

Printer: For producing hard copies of documents.

Speakers: For producing audio output.

Projector: For displaying images on a large screen.

2.3.Storage Peripheral Devices:

These devices store data.

External Hard Drive: For storing large amounts of data.

USB Flash Drive: For portable data storage.

SD Card: For storing data in small devices like cameras and smartphones.

2.4.Networking Peripheral Devices:

These devices connect computers to networks.

Modem: For connecting to the internet.

Router: For connecting multiple devices to a network.

Network Adapter: For enabling a computer to connect to a network.

3. **Identification of computer port.**

A Computer Port: is an interface or a point of connection between the computer and its peripheral devices.

Types of computer ports

Ports: are the physical interfaces on a computer where you connect external devices. Here are some common examples:

Video Ports

HDMI: Delivers high-quality video and audio.

DisplayPort: Offers high-resolution video and audio.

VGA: Older analog video connector.

DVI: Digital video connector.

Data Ports

USB (Universal Serial Bus): Versatile for various devices like keyboards, mice, printers, and external drives.

Thunderbolt: High-speed data transfer, video output, and power delivery.

Ethernet: For wired network connections.

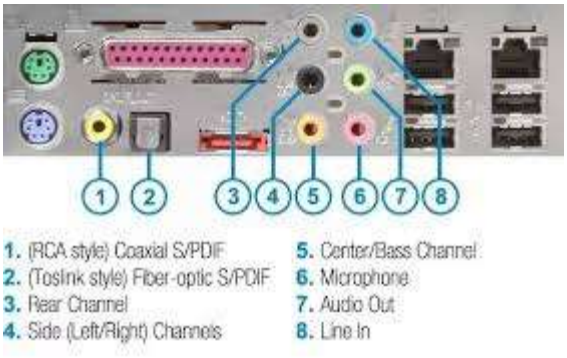
FireWire: Older high-speed data transfer standard.

Serial Port: Older port for connecting various devices.

Parallel Port: Older port for printers and other devices.

PS/2: Older port for keyboards and mice.

Audio Ports



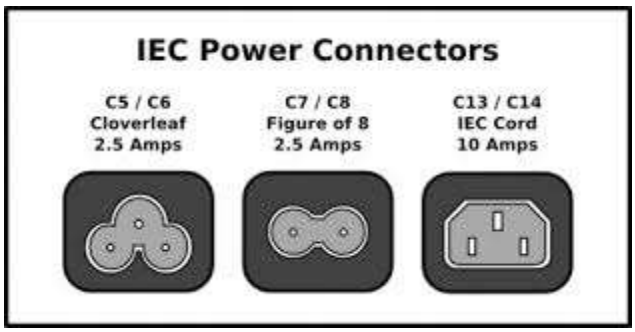
3.5mm Audio Jack: Common for headphones, microphones, and speakers.

HDMI: Can carry audio signals in addition to video.

DisplayPort: Can carry audio signals in addition to video.

Optical Audio For high-quality digital audio.

Power Ports



Power Plug: Connects the computer to the electrical outlet.

Power Connectors: Internal connectors for powering components within the computer.

4. **Identification of computer connectors.**

Computer connectors are the essential interfaces that allow various devices to communicate and interact with a computer.

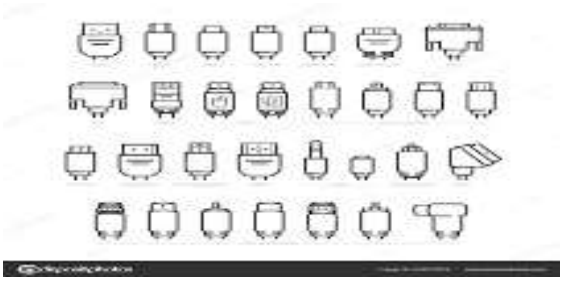
Computer connectors are the physical interfaces that allow various devices to communicate and interact with a computer. They come in different shapes, sizes, and

types, each serving a specific purpose. Computer Connectors: The Bridge between Devices

Types of computer Connectors

Here are some of the most common computer connectors:

- **Video Connectors**



- HDMI (High-Definition Multimedia Interface): Delivers high-quality video and audio signals to displays.
- DisplayPort: Offers high-resolution video and audio, often used for gaming and professional applications.
- VGA (Video Graphics Array): Older analog video connector, still used in some legacy devices.
- DVI (Digital Visual Interface): Digital video connector, gradually being replaced by HDMI and DisplayPort.

- **Data Connectors**

- USB (Universal Serial Bus): Versatile connector for data transfer, power, and device connection.
- Thunderbolt: High-speed data transfer, video output, and power delivery.
- Ethernet: For wired network connections.
- FireWire: Older high-speed data transfer standard.

- **Audio Connectors**

- 3.5mm Audio Jack: Common for headphones, microphones, and speakers.
- HDMI: Can carry audio signals in addition to video.
- DisplayPort: Can carry audio signals in addition to video.
- Optical Audio: For high-quality digital audio.

- **Power Connectors**

- Power Plug: Connects the computer to the electrical outlet.
- Power Connectors: Internal connectors for powering components within the computer.

5. Identification of Power Connection of a Computer

A power connection of a computer is the pathway through which electrical energy is supplied to the various components.

5.1.key term in power connection

Power Supply Unit (PSU): This is the heart of the power system. It converts the AC power from your wall outlet into DC power that the computer can use.

Power Cables: These connect the PSU to the motherboard and other components like the graphics card, hard drives, and fans.

Power Connectors: These are the physical interfaces where the power cables connect to the components.

6. Identification of data connection

A data connection is the pathway through which information is transmitted between devices. It's like a digital highway that allows computers, smartphones, and other devices to communicate and share data.

Network Interface Card (NIC): This is a hardware component that enables a device to connect to a network.

Cables: These physical connections (like Ethernet cables) transport data between devices.

Wireless Connections: Technologies like Wi-Fi and Bluetooth allow for wireless data transfer.

Modems: These devices modulate data signals for transmission over telephone lines or other media

Practical Activity 1.3.2: Connecting computer peripherals

Tasks:

1: Read the Key readings 1.3.2. And Refer to the steps provided in perform the task below.

As a technician you are tasked to connect a computer lab for a small training center.
The lab will accommodate 10 students. Each workstation will require a computer,
Monitor, keyboard, mouse, and internet connectivity.

2: Present your work to the trainer and whole class.

3. In addition, ask questions where necessary.

4: Perform the task provided in application of learning 1.3

Key readings 1.3.2: Connecting computer peripherals

1. **Definition**

Connecting computer peripherals refers to the process of attaching external devices to a computer to extend its functionality. These peripherals include input, output, and storage devices like keyboards, mice, printers, external hard drives, monitors, and more. There are different types of connections that can be used.

2. **Types of connection of a computer peripheral:**

2.1. USB (Universal Serial Bus)

Common Devices: Keyboards, mice, external hard drives, printers, cameras.

How it Works: USB is the most widely used connection for peripherals. Devices with USB connectors are simply plugged into the corresponding USB ports on the computer. Modern USB versions include USB 2.0, USB 3.0, and USB-C, which offer higher data transfer speeds.

Advantages: Easy to use, supports plug-and-play, and provides both data transfer and

power for devices like phones and external drives.

2.2. HDMI (High-Definition Multimedia Interface)

Common Devices: Monitors, TVs, projectors.

How it Works: HDMI cables are used to transmit high-definition audio and video signals from the computer to an external display or TV. Simply plug the HDMI cable into both the computer and the external monitor/TV.

Advantages: Supports high-quality video and audio, widely supported.

2.3. VGA (Video Graphics Array)

Common Devices: Older monitors, projectors.

How it Works: VGA is an analog connection that carries video signals from a computer to an external display device. It is still used with some older equipment but has been largely replaced by HDMI and DisplayPort.

Advantages: Compatibility with older systems.

2.4. Audio Jack (3.5mm)

Common Devices: Headphones, speakers, microphones.

How it Works: The 3.5mm audio jack is used for connecting audio peripherals. Simply plug in the device, and the computer recognizes it as an input or output for sound.

Advantages: Simple to use and compatible with a wide range of audio devices.

3. **Steps to connect computer Peripherals:**

Identify the Port Type: Determine what kind of connection is required by the peripheral (USB, HDMI, Bluetooth, etc.).

Connect the Device: Plug in the device using the appropriate cable or establish a wireless connection.

Install Necessary Drivers: If the computer does not automatically recognize the device, you may need to install drivers (software) to make it function properly.

Configure the Peripheral: Once connected, adjust settings (e.g., display resolution, sound settings, etc.) based on the peripheral.

Test the Device: Ensure the device is functioning as expected.

Points to Remember

- **A computer peripheral or peripheral device** is an auxiliary device used to put information into and get information out of a computer.
- **Types of Peripherals**
- **Input peripheral devices:** Keyboard, Computer mouse, Graphic tablet, Touchscreen, Barcode reader, Image scanner, Microphone, Webcam, Game controller, Light pen, Scanner, Digital camera.
- **Output peripheral devices:** Computer display, Printer, Projector, Speaker.
- **Storage peripheral devices:** Floppy disk drive, Flash drive, Disk drive, Smartphone or Tablet computer storage interface, CD/DVD drive.
- **Input/ Output peripherals devices:** Modem, Network interface controller (NIC).
- **Types of computer ports:** data port, power port, video port, audio port
- **Connecting computer peripherals**
- Refers to the process of attaching external devices to a computer to extend its functionality. These peripherals include input, output, and storage devices like keyboards, mice, printers, external hard drives, monitors, and more. There are different types of connections that can be used.
- **Types of connection of a computer peripheral:** USB (Universal Serial Bus), HDMI (High-Definition Multimedia Interface), VGA (Video Graphics Array), Audio Jack (3.5mm)
- **Steps to connect computer Peripherals:**
- Identify the Port Type
- Connect the Device
- Install Necessary Drivers

- Configure the Peripheral
- Test the Device

Application of learning 1.3

As a computer system assembly technician, you have a new desktop computer, two monitors (one with HDMI, one with Display Port), a USB webcam, an external hard drive (USB), and a USB-C docking station. You want to set up the entire system, ensuring both monitors and USB devices work. What steps would you take to connect the peripherals, and how would you make sure everything works as expected?

Indicative content 1.4: Perform computer system hardware testing

Duration: 5 hrs

Theoretical Activity 1.4.1 Description of computer system hardware testing

Tasks:

1: You are asked to answer the following question:

i. Define computer system hardware testing?
ii. What are the Common Hardware Components to be tested?
iii. Give the types of hardware testing?

2: Provide the answers for the asked questions and write them on flipchart/papers.

3: Present the findings/answers to the whole class.

4: For more clarification, read the **key readings 1.4.1**.

5: In addition, ask questions where necessary.

Key readings 1.4.1.: Description of computer system hardware testing

1. **Definition**

Computer system hardware testing refers to the process of evaluating and diagnosing the physical components of a computer to ensure they are functioning properly and meet the required specifications. Hardware testing is essential for verifying that a computer's internal components, like the CPU, RAM, hard drive, and graphics card, are performing optimally. It also checks external peripherals like keyboards, monitors, and printers for proper functionality. This process is crucial for troubleshooting, maintenance, quality assurance, and performance optimization.

2. **Purpose of computer system Hardware Testing**:

Functional Verification: Ensures that all hardware components are working as intended.

Performance Testing: Checks whether the hardware meets performance expectations, such as speed, power, and efficiency.

Stress and Stability Testing: Puts the system under heavy loads to identify potential failure points and stability issues.

Diagnostic Testing: Helps to pinpoint faulty components, such as malfunctioning RAM, hard drives, or GPUs.

Compatibility Testing: Ensures that different hardware components are compatible with one another.

3. Common Hardware Components to be tested

Central Processing Unit (CPU):

Tests: CPU performance and temperature under various loads, such as during heavy multitasking or gaming. Benchmarks like Prime95 or Cinebench are used to stress-test the CPU to its limits and ensure stability.

Goals: Identify overheating, performance bottlenecks, or faulty processors.

Random Access Memory (RAM):

Tests: Memory diagnostic tools like MemTest86 or Windows Memory Diagnostic are used to test the integrity of RAM modules.

Goals: Detect memory errors, faulty sectors, and ensure that the computer handles memory-heavy tasks without crashing.

Graphics Processing Unit (GPU):

Tests: Stress tests using tools like FurMark, Heaven Benchmark, or 3DMark to evaluate GPU performance under intensive graphical tasks like gaming or video rendering.

Goals: Ensure the GPU can handle high graphics loads without overheating or crashing, and measure frame rates, performance, and temperature.

Hard Drives and Solid-State Drives (HDD/SSD):

Tests: Use tools like CrystalDiskInfo or CHKDSK to check the health, speed, and integrity of storage drives. SSD-specific testing tools help evaluate read/write speeds and life expectancy.

Goals: Identify issues like bad sectors, slow performance, or failing drives, and ensure optimal data transfer speeds.

Motherboard:

Tests: Power-on self-test (POST) during start up evaluates motherboard functionality. Specialized software can check for proper voltages, temperatures, and component communication (e.g., CPU, RAM, storage).

Goals: Ensure all components communicate properly, and identify faulty connections, overheating, or voltage irregularities.

Power Supply Unit (PSU):

Tests: Multimeters or specialized PSU testers measure the voltages being output by the power supply to ensure stability under load.

Goals: Verify that the power supply delivers consistent, adequate power to the system without causing instability.

Cooling Systems (Fans and Heat Sinks):

Tests: Monitoring tools like HWMonitor or Speed Fan measure temperatures across different components (CPU, GPU, and motherboard). Physical inspection can ensure that fans are spinning correctly.

Goals: Prevent overheating, ensure fans and heat sinks are cooling components effectively, and prevent thermal throttling.

Peripheral Devices (Keyboard, Mouse, Monitor, etc.):

Tests: Functional testing involves checking basic input/output operations. Monitors can be tested for dead pixels and colour accuracy using software like Dead Pixel Buddy.

Goals: Ensure all peripherals respond correctly to input, and that displays are clear and free of defects.

4. **Types of computer system Hardware Testing**

Manual Testing:

Involves physically inspecting hardware components, listening for unusual noises (e.g., from hard drives or fans), and running tests manually.

Examples: Opening the case to ensure proper connections, visually inspecting for damage, and checking fans or power supplies.

Automated Testing:

Uses diagnostic software to automatically check the status and performance of hardware components.

Examples: Running diagnostic tools like AIDA64, IntelBurnTest, or OCCT to gather data on CPU, RAM, GPU, and more.

Burn-In Testing:

Puts the system under extreme conditions (such as maximum CPU or GPU load) for an extended period to ensure long-term stability and reliability.

Examples: Running stress tests for 24–48 hours to identify any potential failure points or hardware degradation.

POST (Power-On Self-Test):

A basic diagnostic test that runs automatically when the computer is turned on. It checks critical hardware components (e.g., RAM, CPU, and motherboard) for errors before the operating system boots.

Examples: If a component fails during POST, the computer may beep or display an error code on the screen.

Benchmarking:

Measures the performance of components like the CPU, GPU, or SSD using standardized tests and compares the results to expected benchmarks.

Examples: Running 3DMark for GPUs or Pass Mark for general system performance.

5. **Tools and Software for computer system Hardware Testing**

MemTest86: Tests the integrity of RAM to identify potential errors.

Prime95: Stress tests the CPU to check for stability under load.

CrystalDiskInfo: Provides health reports and performance data for HDDs and SSDs.

AIDA64: Provides detailed diagnostics and stress testing for the entire system, including CPU, GPU, and memory.

OCCT (Overclock Checking Tool): Tests CPU, GPU, and PSU stability under load.

HWMonitor: Monitors the temperatures, voltages, and fan speeds of system components.

Practical Activity 1.4.2 Testing computer system hardware

Tasks:

1: Read the key reading1.4.2. And read the following task.

TRD Company Ltd needs to set up a new workstation for a graphic designer and has requested you to conduct hardware testing to confirm the system's full functionality before delivery. The workstation is equipped with a high-performance CPU, GPU, 32GB of RAM, and a 1TB SSD.

2: List out procedures/steps to be used to perform the given task.

3: Refer to the listed steps in task 2, perform the give task

4. Present your work to the trainer and whole class

5: Perform the task provided in application of learning 1.4

Key readings 1.4.1.: Testing computer system hardware

Main steps be followed considered while testing computer system hardware:

Step 1: Preparation and Safety

- **Turn off the System**: Before opening the case or handling components, ensure the computer is powered down and unplugged from any power source.
- **Check the Environment**: Work in a clean, static-free environment. Use an anti-static wrist strap if available to prevent static electricity from damaging sensitive components.
- **Gather Tools and Software**: Make sure you have the necessary tools (e.g., screwdrivers for opening the case) and software (diagnostic utilities, benchmark tools) ready before starting.

Step 2: Visual Inspection

- **Check for Physical Damage**: Open the computer case and inspect components for physical signs of damage, such as burnt areas on the motherboard, bulging capacitors, broken cables, or dust build up on fans and heat sinks.
- **Ensure Proper Connections**: Verify that all cables (power, data, and peripheral connections) are securely connected. Check that the RAM, GPU, and storage devices are seated properly in their respective slots.

Step 3: Power-On Self-Test (POST)

- **Turn on the Computer**: Power on the system and listen for any POST beep codes or watch for error messages on the screen. Beep codes or error indicators often signal issues with critical components like the RAM, CPU, or motherboard.
- **Diagnose POST Errors**: If you encounter a POST error, refer to the computer's motherboard manual or the manufacturer's website to interpret the beep codes or error messages.

Step 4: Test Individual Components:

- **CPU Testing**
- **Stress Testing the CPU**: Run a CPU stress test using tools like **Prime95**, **IntelBurnTest**, or **AIDA64**. These programs push the CPU to its limits to check stability and monitor temperature.
- **Monitor Temperatures**: Use hardware monitoring software like **HWMonitor** or **Core Temp** to check CPU temperatures while under load. If the CPU overheats or throttles, check the cooling system (fans, heat sinks) and ensure there is proper airflow.
- **Check Performance**: Run a CPU benchmark test using tools like **Cinebench** or **Pass Mark** to compare performance against expected values.
- **RAM Testing**
- **Run Memory Diagnostics**: Use **MemTest86** or **Windows Memory Diagnostic** to test the integrity of the RAM. These tools check for memory errors, faulty sectors, and other issues that can cause system instability.

- **Stress Test Memory**: Run a memory-intensive application or stress test to check for stability under load. Watch for system freezes, crashes, or other errors.

- **GPU (Graphics Card) Testing**
- **Run GPU Stress Tests**: Use software like **FurMark**, **Heaven Benchmark**, or **3DMark** to stress test the GPU under heavy graphical workloads (gaming, rendering, etc.).
- **Monitor GPU Temperatures**: While stress testing, monitor the GPU's temperature using tools like **GPU-Z** or **MSI Afterburner**. Ensure the GPU operates within safe temperature ranges (typically under 85°C during load).
- **Check Performance**: Run GPU benchmark tests and compare the performance to expected benchmarks for your specific graphics card.

- **Hard Drive and SSD Testing**
- **Check Drive Health**: Use **CrystalDiskInfo**, **HD Tune**, or **CHKDSK** (on Windows) to check the health of your storage devices. These tools report on the drive's condition, showing any bad sectors, wear level (for SSDs), or potential signs of failure.
- **Test Performance**: Measure read/write speeds using **CrystalDiskMark** or **AS SSD Benchmark** to verify that the drive is performing within expected ranges. Slow performance or unusual sounds from HDDs may indicate an issue.
- **Check for Errors**: Run disk-checking utilities like **CHKDSK** to scan for file system errors or bad sectors that could lead to data corruption or system crashes.

- **Motherboard and PSU Testing**
- **Check Motherboard Sensors**: Use tools like **HWMonitor** or the BIOS/UEFI hardware monitor to check motherboard voltages, temperatures, and fan speeds. If voltages are unstable, it may indicate a problem with the power supply unit (PSU) or motherboard.
- **Test the Power Supply (PSU)**: Use a **PSU tester** or a **multimeter** to check the output voltages of the PSU. Ensure the voltages are within the correct range (e.g., 12V, 5V, 3.3V) for stability.
- **Monitor Stability**: Run system-wide stress tests using software like **OCCT**, which tests both the CPU and PSU by putting the system under load to check for voltage stability and power delivery.

- **Peripheral Testing**

- **Keyboard and Mouse**: Test input devices by checking their responsiveness. Ensure they register inputs correctly and without delay. If wireless, check battery levels or connectivity issues.
- **Monitor**: Check for display quality and dead pixels using tools like **Dead Pixel Buddy**. Verify resolution and refresh rate settings in the display settings.
- **Audio Devices**: Test speakers, headphones, and microphones to ensure proper audio input and output. Adjust settings in the audio control panel and verify sound clarity.
- **Printer, Webcam, etc.**: Run test operations on printers (e.g., print a test page) and test webcams or scanners using their respective software or settings menu.

Step 5: Review Test Results

- **Analyze Diagnostics**: Review the results from all diagnostic and benchmarking tools. Compare performance and stability results to the expected performance for each component.
- **Address Failures**: If any component fails a test, investigate further. For example, if RAM shows errors in MemTest86, try reseating the modules or replacing the faulty stick. If a hard drive shows bad sectors, consider backing up data and replacing the drive.

Step 6:Document and Report

- **Create a Report**: Document all findings, including benchmark results, temperatures under load, and any issues encountered. This report can be used for maintenance, troubleshooting, or warranty claims if hardware is underperforming or failing.

Points to Remember

- **Computer system hardware testing** refers to the process of evaluating and diagnosing the physical components of a computer to ensure they are functioning properly and meet the required specifications.

- **Purpose of Hardware Testing**:
  - ✓ Functional Verification
  - ✓ Performance Testing
  - ✓ Stress and Stability Testing
  - ✓ Diagnostic Testing**:**
  - ✓ Compatibility Testing

- **Common Hardware Components Tested**
  - ✓ Central Processing Unit (CPU)
  - ✓ Random Access Memory (RAM)
  - ✓ Graphics Processing Unit (GPU)
  - ✓ Hard Drives and Solid-State Drives (HDD/SSD)
  - ✓ Motherboard
  - ✓ Power Supply Unit (PSU)
  - ✓ Cooling Systems (Fans and Heat Sinks)
  - ✓ Peripheral Devices (Keyboard, Mouse, Monitor, etc.)

- **Types of Hardware Testing**
  - ✓ Manual Testing
  - ✓ Automated Testing
  - ✓ Burn-In Testing
  - ✓ POST (Power-On Self-Test
  - ✓ Benchmarking

- **Tools and Software for Hardware Testing**
  - ✓ MemTest86
  - ✓ Prime95
  - ✓ CrystalDiskInfo
  - ✓ AIDA64
  - ✓ OCCT (Overclock Checking Tool)
  - ✓ HWMonitor

- **Steps in the Hardware Testing Process**

  - ✓ Preparation and safety
  - ✓ Visual Inspection
  - ✓ Run POST
  - ✓ Test Individual Components
  - ✓ Review testing Results
  - ✓ Document and Report

Application of learning 1.4.

A user reports that their desktop computer, which is primarily used for graphic design and video editing, has recently been experiencing significant slowdowns, particularly when rendering large video files. Additionally, the system has started freezing intermittently, and on two occasions, it has shut down unexpectedly. The user also mentions noticing strange graphical artifacts on the screen during these freezes. You are tasked perform hardware testing on the computer to identify and fix the problem.

Learning outcome 1 end assessment

Written assessment

A. Read the following statement and choose he correct answer by circling the corresponding letter

1. **What is the primary function of a Central Processing Unit (CPU)?**
   - A. Controls the flow of data
   - B. Stores data
   - C. Displays graphics
   - D. Processes instructions
2. **Which component is responsible for storing data permanently?**
   - A. RAM
   - B. ROM
   - C. Hard Drive
   - D. Motherboard
3. **What is the primary function of a graphics card (GPU)?**
   - A. Processes text
   - B. Controls the operating system
   - C. Renders graphics
   - D. Stores data
4. **What is the correct order of components to be installed in a computer case?**
   - A. Motherboard, CPU, RAM, GPU, Storage, Power Supply
   - B. Power Supply, Motherboard, CPU, RAM, GPU, Storage
   - C. CPU, Motherboard, RAM, GPU, Storage, Power Supply
   - D. Storage, GPU, RAM, CPU, Motherboard, Power Supply
5. **How can you identify a hardware failure?**
   - A. By checking the event logs
   - B. By listening for unusual noises
   - C. By running diagnostic tools
   - D. By looking for error messages

6. **What is the recommended frequency for cleaning computer components to prevent overheating?**

    A. Monthly

    B. Quarterly

    C. Annually

    D. Never

B. Matching questions

7. **Match the following hardware components with their functions**

Answer	Hardware	Functions
1……..	1. HDD	A. Stores data permanently
2……..	2. RAM	B. Processes instructions and data
3……..	3. GPU	C. Print out the document
4……..	4. Motherboard	D. Renders graphics
5……..	5. CPU	E. Store data temporarily
		F. Connects all components

8. **Match the following BIOS settings with their purposes:**

A. Boot Sequence - [ ] Determines the order in which devices are booted
B. CPU Configuration - [ ] Sets the CPU clock speed and voltage
C. Storage Settings - [ ] Configures hard drives, SSDs, and optical drives
D. Peripheral Configuration - [ ] Sets up USB ports, audio devices, and other peripherals
E. BIOS Setting

9. **Filling in the Blanks: in provided space fill the corrected word**

1. _____ is the main printed circuit board in a computer.
2. _____ is a type of volatile memory used for short-term data storage.
3. _____ is a software program that controls the basic functions of a computer.
4. _____ is the process of installing and configuring hardware components.
5. _____ is a common tool used for diagnosing hardware issues.

C. Open questions

Q1.Question:

A user reports frequent system crashes and blue screens of death (BSODs) when running multiple programs on their computer. You suspect the issue might be with the RAM. How would you perform a hardware test to diagnose faulty RAM, and what tools or steps would you use?

Q2.Question:

A user is experiencing slow performance, frequent freezing, and unusual noises coming from their computer's hard drive. You suspect the hard drive is failing. What steps would you take to test the health of the hard drive, and what tools can be used to verify the problem?

Q3.Question:

A desktop computer frequently powers off unexpectedly or fails to boot up. You suspect the **power supply unit (PSU)** might be failing. How would you test the PSU to confirm whether it's functioning properly, and what steps or tools would you use for this?

Practical assessment

You have been tasked with setting up a new office computer for an employee. The system comes disassembled, and your job is to deploy the system, connect all the hardware components, peripherals, and ensure it functions properly before use. How would you approach the deployment of this new computer system, identify the main hardware components, connect the necessary peripherals, and test the system to ensure it is ready for the employee to use?

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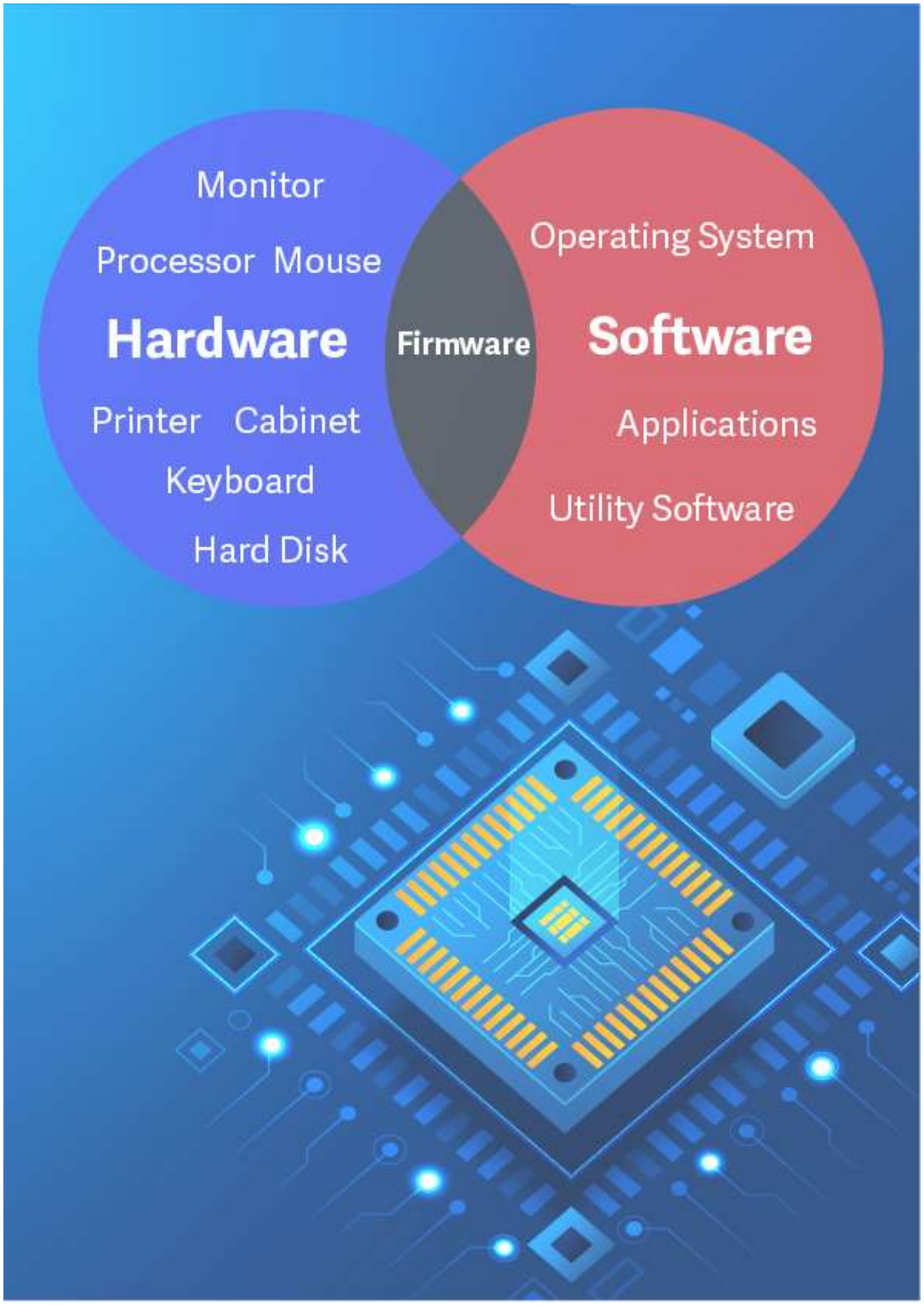
Monitor
Processor Mouse
Hardware
Printer Cabinet
Keyboard
Hard Disk
Firmware
Operating System
Software
Applications
Utility Software

Indicative contents
2.1 Description of computer firmware
2.2 Performing computer firmware installation
2.3 Maintain Computer firmware

Key Competencies for Learning Outcome 2: Install computer firmware

Knowledge	Skills	Attitudes
• Description of computer firmware. • Description of computer BIOS. • Identification of BIOS functions • Description of computer firmware updates, upgrade and repair	• Configuring computer firmware. • Performing firmware installation. • Applying computer firmware updates, upgrade and repair. • Performing diagnoses and troubleshoot issues related to firmware.	• Being responsible • Having curiosity • Having Patience • Being able to follow instructions

Duration: 15 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly computer firmware based on hardware compatibility.
2. Install properly computer firmware based on hardware compatibility.
3. Maintain effectively computer Firmware based on hardware compatibility.
4. Perform correctly computer firmware updates, upgrade and repair based on hardware functionality.

Resources

Equipment	Tools	Materials
• Power supply • Motherboard • Computer	• USB 2.0	• Firmware • internet bundles

Indicative content 2.1: Description of computer firmware

Duration: 5 hrs

Theoretical Activity 2.1.1: Identification of computer firmware

Tasks:

1. Answer the following question

   i. What is computer firmware?
   ii. Give the functions and Roles of computer firmware.
   iii. What do you understand by term BIOS?
   iv. Differentiate UEFI and Legacy BIOS.

2. Trainees are writing their findings or answers on flipchart.
3. Trainees present their findings
4. Trainees follow expert view and ask questions if any.
5. For more clarification read the key reading 2.1.1

Key readings 2.1.1: Identification of computer firmware

1. COMPUTER FIRMWARE

1.1 Definition of computer firmware

Firmware is a microcode or program that is embedded into the memory of hardware devices to help them operate.

Or

Firmware is software that provides basic instructions that enable hardware to function and communicate with other software.

1.2 Types of Firmware

1.2.1 Types of firmware based on Level of Abstraction

- **Low-level firmware:** This is the most basic level of firmware, responsible for initiating hardware components and performing essential functions.

  This software is stored on non-volatile memory chips like ROM, PROM, and PLA. This level is considered an intrinsic part of the hardware since low-level Firmware are stored on read-only chips that cannot be updated.
  Examples include BIOS/UEFI in computers, bootloaders, and device drivers.

- **High-level firmware:** This firmware operates closer to the application level, managing more complex device functionalities.

  To allow for updates, this Firmware are used with flash memory chips. Compared to Low-level Firmware, they have often more complex instructions and makes it closer to software than hardware.
  Examples include printer firmware, digital camera firmware, and smartphone operating systems.

- **Subsystem firmware:** This type manages specific subsystems within a larger system.

  Semi-independent unit of a larger system is called a Subsystem. Since this level has its microcode embedded in CPU, LCD units, and flash chips, like High-level Firmware. Examples include network interface card (NIC) firmware, graphics card firmware, and hard drive firmware.

1.2.2 Types of firmware based on Function

- **Bootloader:** This firmware initializes the system and loads the operating system.
- **Device driver:** This firmware interacts with specific hardware components, providing an interface for the operating system.
- **Real-time operating system (RTOS):** Some devices use embedded RTOS for real-time control and management.

- **Application-specific firmware:** This firmware is tailored to specific devices and applications, such as printer firmware or digital camera firmware.
- **BIOS (Basic Input/output System):** The firmware that manages basic computer hardware functions.
- **UEFI (Unified Extensible Firmware Interface):** A newer, more flexible replacement for BIOS.
- **Microcode:** Low-level firmware embedded in processors to correct hardware errors or enhance performance.

1.3 Storage Medium that store firmware

- **ROM (Read-Only Memory):** Older devices used ROM to store firmware, which was permanent and could not be modified.
- **EPROM (Erasable Programmable Read-Only Memory):** This type allowed firmware to be erased and reprogrammed, but required special equipment.
- **Flash memory:** Most modern devices use flash memory for firmware storage, allowing for easy updates and modifications.

1.4 The functions of firmware

1. **Booting the System**: Firmware initializes hardware components and loads the operating system during startup.
2. **Hardware Control**: Firmware manages and controls the basic operations of hardware components (e.g., keyboard, display, storage).
3. **Device Communication**: Firmware facilitates communication between hardware and software by providing low-level control instructions.
4. **Security Management**: Firmware helps enforce security protocols, like secure boot, to protect against unauthorized access.
5. **Firmware Updates**: Enables updates to improve device functionality or patch security vulnerabilities.

1.5 The roles of firmware

1. **Interfacing Hardware and Software**: Firmware acts as a bridge between hardware components and the operating system, enabling them to work together.
2. **Providing Basic Control Instructions**: It gives the essential control programs needed to manage the hardware, allowing the system to function properly.
3. **System Initialization**: Firmware is responsible for booting up the system by initializing hardware components and loading the operating system.
4. **Maintaining Stability and Security**: It ensures stable operation by handling low-level tasks and supports secure processes like authentication and updates.
5. **Enabling Device-Specific Functions**: Firmware provides the specialized instructions that allow devices (e.g., printers, routers) to perform their unique functions.

2. BASIC INPUT/OUTPUT SYSTEM

2.1. Definition of BIOS

A basic input/output system (BIOS) is a preinstalled program used during start-up on Windows-based computers.

The CPU initially accesses the BIOS, after which the operating system is loaded. A basic input/output system is also known as system BIOS or ROM BIOS.

The BIOS is built-in software that contains generic code required to control the keyboard, display screens, disk drives and other functions.

The **primary purpose** of the BIOS is to set up hardware and further load and start an operating system. BIOS is placed in a non-volatile ROM chip inside the computer, ensuring the availability of BIOS at all times and preventing accidental disk failure.
The BIOS checks every hardware connection and locates the devices, after which the operating system is loaded into computer memory.

BIOS software is designed to work with the various devices that make up a complimentary system chipset. The BIOS library has certain functions used to operate and control system peripherals, which can be initiated by an external software.

2.2.Types of BIOS

- **Legacy BIOS:** The traditional BIOS architecture, using a character-based interface.

  Older motherboards have legacy firmware on the BIOS to turn the PC on. Although it governs how the CPU and the components communicate, like UEFI, Legacy BIOSes have other limitations. These can't identify drives bigger than 2.1 TB, and their setup programs have text-only menus.

- **UEFI (Unified Extensible Firmware Interface):** A newer, more flexible BIOS standard with a graphical interface and support for larger hard drives.

  UEFI (Unified Extensible Firmware Interface) can accommodate 2.2 TB or larger drives by using the Master Boot Record (MBR) approach in place of the more modern GUID Partition Table (GPT) technology.

  Although Intel PCs migrate away from Legacy BIOS and towards UEFI firmware, BIOS has never been used by Apple's Mac PCs.

2.3.Function of BIOS

2.3.1.Functions of BIOS user interface

- Setting the system clock
- Enabling and disabling certain system components
- Hardware configuration
- Selecting boot drives
- Set password prompts for secured access to BIOS user interface function

Modern PCs have BIOS stored in rewritable memory, permitting contents to be rewritten or replaced. Such content rewriting is called flashing and is executed through a special program provided by system manufacturers.

This also requires a test called a POST (Power-On Self-Test) to verify whether the device meets the needs of booting correctly.

If the POST is not passed by the computer, a combination of beeps is received which shows something is wrong with the machine.

The BIOS firmware is non-volatile, which means it saves and restores its settings even after power from the system is disconnected. The OS is mid-range software because it communicates with both high-level software and hardware components directly via the drivers and BIOS.

In other words, the BIOS provides a variety of services that allow users to configure and get direct information from hardware components inside computers. The BIOS serves as a mediator between the Input / Output devices (I / O devices) and the CPU until the booting cycle is complete.

It is not necessary to have all the hardware details attached for the Operating System or the process running on your computer. All computer hardware specifics are known to the BIOS and are handled by it. The information must be communicated to the BIOS, whenever the IO interface's information changes.

2.3.2 Key Functions of BIOS

- **Power-On Self-Test (POST):** Checks hardware components for errors and initializes them.

  The first and foremost task of BIOS is to ensure the proper functioning of the computer hardware, and there is no hardware problem. Power-On Self-Check (POST) does this task efficiently. If the POST test fails, the computer produces different forms of beeps to show the error type. If the POST test is passed then it continues to boot.

- **Bootloader:** Loads the operating system from storage (hard drive, SSD, etc.).

  Booting: Upon successfully running POST, the BIOS locates and recognizes the operating system. The BIOS then transfers access to Operating System when it detects one. This is called Booting.

- **Configuration Settings:** Allows users to modify system settings (boot order, clock speed, etc.).
- **Basic Input/output (I/O) Handling:** Manages communication between the operating system and hardware devices.

  BIOS drivers: BIOS drivers are a set of programs that are stored in the erasable memory chips which are non-volatile. The BIOS Drivers supplies basic computer hardware information.

  BIOS Setup: Configuration software that allows you to configure hardware settings including the device settings, computer passwords, time and date. BIOS setup is also called a CMOS setup.

Importance of BIOS

The BIOS is the basic and essential portion of the Motherboard Firmware and is in charge of checking and booting the hardware attached to the device, thereby passing the computer control to the Operating system.

- **System Boot-up:** Essential for starting the computer and loading the operating system.
- **Hardware Configuration:** Allows users to customize system settings.
- **Overclocking:** Enables advanced users to modify system performance (though often not recommended).
- **Troubleshooting:** Helps diagnose hardware issues during the boot process.

Reasons to update the BIOS and Advantages of updating the BIOS

● **Hardware updates:** New BIOS updates would allow the motherboard to correctly recognize new hardware including processors, RAM, etc. If you have updated your processor, and the BIOS does not recognize it, the answer could be a BIOS flash.

● **Security updates**: The new BIOS updates come with security upgrades that help your BIOS withstand tampering and increase awareness of viruses in the boot sector (if your motherboard supports boot sector scanning).

● **Increased stability:** As bugs and other problems with motherboards are discovered, the manufacturer will release BIOS updates to address and rectify those bugs. This can directly affect the data transfer and processing speed.

Practical Activity 2.1.2: Navigating BIOS Settings

Tasks:

1: Referring to the **key readings 2.1.2** you are requested to perform the following task.

You have a task of checking if a computer have BIOS system, then after accessing the BIOS, co nfigure the boot order to prioritize booting. After making the changes, save and exit the BIOS.

2: Present your final works to your trainer/classmates

3: Ask for clarification where it is necessary.

Key readings 2.1.2:

Navigating BIOS Settings

1.Ways to navigate to BIOS (Basic Input Output System)

1.1 Steps to Access the BIOS and Configure Boot Order

1. **Restart the Computer**
    - If the computer is already on, restart it. If it's off, power it on.
2. **Access the BIOS**

- As the computer starts, repeatedly press the designated BIOS key (commonly **F2**, **F10**, **Delete**, or **Esc**, depending on the computer manufacturer).
- The BIOS menu should appear.

3. **Navigate to the Boot Menu**
   - Use the arrow keys on your keyboard to navigate through the BIOS menu.
   - Look for the option labeled **Boot** or **Boot Order**.
4. **Change Boot Order**
   - Under the **Boot** menu, locate the list of boot devices.
   - Use the keys specified in the BIOS (often + or - or function keys like F5 and F6) to move the **USB** device or the desired boot device to the top of the list.
5. **Save Changes**
   - Once the boot order is set, press the key to save the changes (usually **F10**).
   - Select **yes** or **OK** when asked to confirm saving changes.
6. **Exit the BIOS**
   - After saving, the computer will automatically exit the BIOS and restart with the new boot order.

The BIOS is accessed via the **BIOS Setup Utility** and configured there. All options available in BIOS are configurable via the BIOS Setup Utility.

Unlike an operating system such as Windows, which is often downloaded or accessed on a disk and needs to be installed by the user or manufacturer, BIOS comes installed as soon as the computer is manufactured.

1.2 Depending on the computer manufacture and model of the machine or motherboard the BIOS Configuration Function is accessed in various ways.

METHOD 1: USE THE BIOS KEY DURING STARTUP

1. Restart your PC.
2. When the manufacturer logo appears, press the designated BIOS key repeatedly until you enter BIOS setup. Common BIOS keys by brand include:
   1. Acer: F2 or DEL
   2. ASUS: F2 or DEL
   3. Dell: F2 or F12
   4. HP: ESC or F10
   5. Lenovo: F2 or Fn + F2

6. MSI: DEL

3. Use the arrow keys to navigate the BIOS menu.

Some PCs boot too quickly to hit the BIOS key in time. In this case, move on to method 2 below or try disabling Fast Start-up in Windows.

METHOD 2: USE WINDOWS ADVANCED START MENU TO ACCESS UEFI FIRMWARE SETTINGS

1. Click Start and select Settings.
2. Go to Update & Security.
3. Under Recovery, click Restart now.
4. On the Choose an Option screen, select Troubleshoot.
5. Click advanced options.
6. Select UEFI Firmware Settings.
7. Click Restart to reboot into BIOS

1.3 The specific method to access the BIOS configuration varies widely depending on the computer manufacturer and model.

1.3.1 Here are some common ways to enter BIOS

- **Press a specific key during boot:** This is the most common method. The key is usually displayed on the screen during the boot process. Common keys include **Delete**, **F2**, **F10**, **Esc**, or **Ctrl+Alt+Delete**.
- **Press a combination of keys:** Some computers require pressing a combination of keys, like **Ctrl+Alt+Esc** or **Ctrl+Alt+Delete** followed by a specific key.
- **Using a boot menu:** Some motherboards have a boot menu that can be accessed by pressing a specific key during the boot process. This menu often includes an option to enter BIOS setup.

Note: If you're unsure which method to use for your specific computer, check these

- **Check the documentation:** Your computer's manual or user guide should provide instructions on how to access the BIOS.
- **Look for on-screen prompts:** During the boot process, pay attention to any messages on the screen that might indicate the key to press.
- **Try common keys:** If you can't find the information in the documentation or on-screen, try pressing common BIOS entry keys like Delete, F2, or F10.

- Once you've **successfully** entered the **BIOS setup**, you can navigate through the menus and options to configure various settings.

Points to Remember

- **Computer firmware** is software that provides basic instructions that enable hardware to function and communicate with other software.
- **Functions and roles of computer firmware** include initializing hardware, managing boot processes, and ensuring communication between hardware and software.
- **BIOS** (Basic Input/output System) is firmware that initializes hardware during boot-up and manages data flow between the OS and hardware.
- **UEFI** offers a modern interface, faster boot times, and better security than **Legacy BIOS**, which is older and more limited.

➢ **Steps to Identify the BIOS System on a Computer**

1. Restart the Computer
2. As the computer starts, repeatedly press the designated BIOS key.
3. Navigate to the Boot Menu
4. Change Boot Order
5. Save Changes
6. Exit the BIOS

Application of learning 2.1.

ABC Company needs a technician to fix computer BIOS settings in order to increase functionality. What BIOS setting could be used, and how might you change it?

Indicative content 2.2: Performing computer firmware installation

Duration: 5 hrs

Theoretical Activity 2.2.1: Description of computer firmware installation

Tasks:

1: Answer the following question

i. Describe a Compatibility Check-up.

ii. What are the compatibility Check-up of motherboard, Operating system and format USB Drive as FAT32.

iii. Explain steps to follow in installation of firmware.

2: Trainees present their findings.

3: Trainees follow expert view.

4: trainees read the key reading 2.2.1 in trainee's manual.

Key readings 2.2.1.:

1.Description of computer firmware installation

1.1 Definition of compatibility check-up

A **compatibility check-up** is a process of verifying that software or hardware can function correctly and work in different environments or with other systems.

It ensures that the application or device works as expected across various configurations, such as:

- **Operating systems:** Windows, macOS, Linux, Android, iOS
- **Hardware:** Different processors, graphics cards, storage devices, and peripherals
- **Software:** Other applications or programs that may interact with the tested component

- **Networks:** Different network environments (e.g., Wi-Fi, Ethernet)

1.2 Compatibility check-up of firmware installation

A compatibility check-up of firmware installation ensures that the new firmware version is compatible with the hardware and software components of the system.

This involves verifying that the firmware functions correctly and without errors, and that it doesn't cause any conflicts or instability.

1.2.1 Key areas to consider for firmware installation compatibility

1. **Hardware Compatibility**
    - **Processor:** Ensure the firmware is compatible with the specific processor model and architecture.
    - **Memory:** Verify that the firmware doesn't exceed the available memory capacity.
    - **Storage:** Ensure compatibility with the storage device (e.g., HDD, SSD).
    - **Peripherals:** Check if the firmware supports all necessary peripherals (e.g., network adapters, USB devices).
2. **Software Compatibility**
    - **Operating System:** Verify compatibility with the installed operating system (e.g., Windows, macOS, Linux).
    - **Other Applications:** Ensure the firmware doesn't conflict with other installed software or drivers.
    - **Drivers:** Update or install any necessary drivers for the new firmware.
3. **Functionality:**
    - **Core Features:** Verify that all essential features of the firmware are working as expected.
    - **Performance:** Assess the performance impact of the new firmware (e.g., speed, stability).

- **Compatibility with External Devices:** Test compatibility with other devices or systems that interact with the firmware.

1.2.2 Methods for Compatibility Check-up

- **Manufacturer's Guidelines:** Consult the manufacturer's documentation or website for specific compatibility information.
- **Beta Testing:** Test the firmware in a controlled environment before deploying it to production systems.
- **Compatibility Matrices:** Refer to compatibility matrices provided by the manufacturer or third-party sources.
- **User Testing:** Gather feedback from users to identify any compatibility issues or unexpected behavior.

1.3 Compatibility Check-up of motherboard, Operating system and format USB Drive as FAT32

1.3.1 Motherboard

Motherboard: The main printed circuit board (PCB) in a computer that connects all the components together, including the CPU, RAM, GPU, storage devices, and expansion cards.

Motherboard Compatibility

- **Processor Compatibility:** Verify if the motherboard supports the processor you intend to use.
- **Chipset Compatibility:** Ensure that the motherboard's chipset is compatible with the firmware and other components.
- **Form Factor:** Check that the motherboard's form factor (e.g., ATX, MicroATX) is compatible with your case and other components.
- **BIOS/UEFI Compatibility:** Verify that the motherboard's BIOS or UEFI supports the firmware installation process and features.

1.3.2 Operating system

Operating System: The software that manages the computer's hardware and software resources.

Examples include Windows, macOS, Ubuntu, Android, Linux,...

- **Operating System Compatibility**

- **Version Compatibility:** Ensure that the operating system version is compatible with the firmware and motherboard.
- **Drivers:** Check if the operating system has the necessary drivers for the motherboard and its components.
- **BIOS Support:** Verify that the operating system is compatible with the BIOS or UEFI version on the motherboard.

1.3.3 Format USB Drive as FAT32

- **FAT32:** A file system commonly used for flash drives and other removable storage devices. It has a maximum file size limit of 4 GB.

- **Formatting USB Drive as FAT32**

- **Storage Capacity:** Ensure that the USB drive has sufficient storage capacity for the firmware file.
- **Formatting:** Format the USB drive as FAT32 using a compatible file system tool (e.g., Disk Management in Windows, Disk Utility in macOS).
- **Verify Format:** Check that the USB drive is formatted correctly and can be recognized by the computer.

1.4.Important of Compatibility Check-up

A compatibility check-up is crucial for ensuring the smooth operation and optimal performance of hardware and software components.

- It helps to prevent potential issues and conflicts that can arise when components are not compatible with each other.
- **Avoids System Crashes:** Incompatible components can lead to system crashes, data loss, and other serious problems.
- **Ensures Optimal Performance:** Compatible components work together efficiently, maximizing system performance and resource utilization.
- **Prevents Errors and Glitches:** Compatibility issues can cause errors, glitches, and unexpected behavior.
- **Enhances User Experience:** A compatible system provides a smoother and more enjoyable user experience.
- **Facilitates Upgrades and Updates:** Compatibility checks help ensure that new hardware or software can be seamlessly integrated into the existing system.
- **Reduces Troubleshooting Time:** By identifying compatibility issues upfront, you can save time and effort on troubleshooting and problem-solving.

2. Firmware compatibility

Firmware compatibility refers to the ability of firmware to work correctly with the hardware and software of a system.

Firmware is a type of software embedded in hardware that controls its operations. Compatibility ensures that the firmware properly interfaces with all system components and functions as intended.

Practical Activity 2.2.2: Performing computer firmware installation

Task:

1: Referring to the **key readings 2.2.2** you are requested to perform the following task.

You need to increase your computer performance due to the bad issue of late start-up. Perf orm new BIOS firmware installation in your computer.

2: present your final works to your trainer/classmates

3: Ask for clarification where it is necessary.

Key readings 2.2.2:

1. **Perform Computer Firmware Installation**

Firmware installation is the process of updating or replacing the software embedded in hardware devices.

To install the Firmware's. Non-removal of the USB Flash drive or not turning off the instrument's power is necessary.

There are prerequisites to follow in order to get firmware software, download the firmware, the zip file is downloaded to the computer.

Connect the device to the USB flash drive, the computer is connected to a USB flash drive and *.prg file is extracted and copied to the root directory of your device. Find the downloaded files to the USB. Then, install the Firmware by following the on screen instructions as series of different messages will be displayed.

Once the update is completed, you will see a pop-up window which confirms that it is installed successfully. You can now remove the USB drive from the slot.

1.1.Key consideration before firmware installation

- **Compatibility:** Always verify that the firmware is compatible with your device model and operating system.
- **Backup:** Create a backup of your data before installing firmware updates to protect against potential data loss.
- **Power Supply:** Ensure a stable power supply during the installation process to prevent interruptions.
- **Follow Instructions:** Carefully follow the manufacturer's instructions for the specific firmware update process.
- **Seek Assistance:** If you encounter any difficulties, consult the manufacturer's documentation or seek technical support.

1.2. Steps of Installing Firmware

1. **Gather Information**
    - **Device Model:** Identify the specific model of the device for which you're installing firmware.
    - **Firmware Version:** Determine the current firmware version and the

desired new version.
    - **Compatibility:** Check for any compatibility requirements or restrictions.
2. **Download Firmware**
    - Locate the firmware file from the manufacturer's website or a trusted source.
    - Ensure the downloaded file is the correct version for your device.
3. **Prepare for Installation**
    - **Backup Data:** Create a backup of important data on your device before proceeding with the installation.
    - **Power Supply:** Ensure that the device is connected to a stable power source.
    - **Disable Automatic Updates:** Temporarily disable automatic updates to prevent conflicts.
4. **Access Firmware Update Mode**
    - Follow the manufacturer's instructions to enter the firmware update mode. This may involve pressing specific keys during boot or using a dedicated update tool.
5. **Load Firmware**
    - Use the device's built-in update utility or a separate tool to load the downloaded firmware file.
    - Follow the on-screen instructions carefully.
6. **Installation Process**
    - The firmware installation process may vary depending on the device. It might involve extracting files, flashing the firmware, or using a specific update tool.
    - Be patient as the installation process can take some time.
7. **Verification**
    - After the installation is complete, verify that the new firmware version is installed correctly.
    - Check for any changes in the device's behaviour or features.
8. **Reboot**
    - Restart the device to apply the new firmware and ensure its functioning properly.

2. INSTALLATION OF BIOS FIRMWARE

a. Key consideration before BIOS installation

- **Power Supply:** Ensure that your computer is connected to a stable power source during the BIOS update process.
- **Backup:** Create a backup of your BIOS settings before making any changes.
- **Seek Assistance:** If you encounter any difficulties or are unsure about any steps, consult your motherboard manufacturer's documentation or seek technical support.

b. BIOS Installation Steps

1. **Gather Information**
    - **BIOS Version:** Determine the current BIOS version on your system.
    - **Compatibility:** Ensure that the new BIOS version is compatible with your hardware and operating system.
    - **Backup:** Create a backup of your important data before proceeding.
2. **Download BIOS Update**
    - Visit your motherboard manufacturer's website and download the latest BIOS update file for your specific model.
3. **Prepare a USB Drive**
    - Format a USB drive with a compatible file system (e.g., FAT32) and copy the BIOS update file to it.
4. **Enter BIOS Setup**
    - Restart your computer and press the designated key (usually Delete, F2, F10, or Esc) during the boot process to enter BIOS setup.
5. **Locate BIOS Update Utility**
    - Navigate to the BIOS update utility or flash tool within the BIOS setup. The exact name may vary depending on your motherboard manufacturer.
6. **Load BIOS Update**
    - Use the BIOS update utility to locate and select the BIOS update file on your USB drive.
7. **Start Update**
    - Follow the on-screen instructions to initiate the BIOS update process. This may involve confirming the update and restarting your computer.
8. **Verification**
    - After the update is complete, restart your computer and verify that the new BIOS version is installed. You can usually find the BIOS version information in the BIOS setup or by using a system information tool.

Note: BIOS (Basic Input/output System) updates should be performed with caution and only when necessary. Incorrect updates can lead to system instability or failure. Always consult your motherboard manufacturer's documentation for specific instructions.

Points to Remember

- A compatibility check-up ensures that hardware and software components work seamlessly together, preventing issues and optimizing performance.
- **FAT32:** A file system commonly used for flash drives and other removable storage devices. It has a maximum file size limit of 4 GB.
- **Firmware compatibility** refers to the ability of firmware to work correctly with the hardware and software of a system.

Steps to install firmware

- Gather Information
- Download Firmware
- Prepare for Installation
- Access Firmware Update Mode
- Load Firmware
- Installation Process
- Verification
- Reboot

Application of learning 2.2.

XYZ Company need a technician to install the firmware on a company's laptop, what specific steps would you take to ensure a successful and safe installation, considering the potential challenges and risks associated with firmware updates in laptop?

Indicative content 2.3: Maintain Computer firmware

Duration: 5 hrs

Theoretical Activity 2.3.1 Description of computer firmware maintenance.

Tasks:

1: Answer the following question

i. What is the difference between BIOS update and BIOS upgrade?
ii. Why is it important to back up your current BIOS configuration before applying an update or upgrade?
iii. Describe BIOS Repair Settings.

2: Trainees present their findings

3: Trainees follow expert view and ask them to note the key point.

4: Trainees are reading the key reading 2.3.1

Key readings 2.3.1.:

Description of computer firmware maintenance

1. Description of BIOS update

BIOS updates can be traced back to the early days of personal computers. Initially, BIOS was stored in read-only memory (ROM), making it difficult to modify. However, as technology advanced, methods were developed to update the BIOS, allowing for improvements and bug fixes.

1.1. Definition of BIOS update

A **BIOS update** is the process of replacing the firmware that controls the basic input/output system of a computer.

It involves updating the software that manages communication between the operating system and hardware components.

1.2 Reasons of BIOS Updates

- **Bug Fixes:** BIOS updates can address bugs or errors that may cause system instability or crashes.
- **Security Patches:** Updates can include security patches to protect against vulnerabilities.
- **Hardware Compatibility:** BIOS updates can improve compatibility with new hardware components or devices.
- **Feature Enhancements:** Some updates may introduce new features or improve existing ones.

1.3 Key Considerations before updating BIOS.

- **Risk:** Updating the BIOS can be risky, as a failed update could render your computer inoperable.
- **Backup:** Always create a backup of your important data before updating the BIOS.
- **Power Supply:** Ensure a stable power supply during the update process to avoid interruptions.
- **Manufacturer's Instructions:** Follow the specific instructions provided by your motherboard manufacturer for updating the BIOS.

2. Description of BIOS upgrade

2.1 Definition of BIOS Upgrade

A BIOS upgrade is a more significant update than a BIOS update, often involving a complete replacement of the BIOS chip or firmware.

It typically introduces major changes or new features to the system's functionality.

2.2 Reasons of BIOS Upgrades

- **Major Hardware Changes:** When upgrading to a new processor or motherboard, a BIOS upgrade may be necessary to ensure compatibility and support for the new hardware.
- **New Features:** BIOS upgrades can introduce new features or capabilities, such as support for advanced hardware technologies or security enhancements.
- **Performance Improvements:** Some BIOS upgrades can improve system performance or address specific performance issues.

3. Key Differences Between BIOS Updates and Upgrades

Elements	Update	Upgrade

➢ Scope	Focus on bug fixes, security patches, and minor improvements.	Involve more significant changes to the system's functionality.
➢ Installation Method	Are often performed through the BIOS itself.	Require physical access to the motherboard to replace the BIOS chip or flash the firmware.
➢ Risk	Low risk of failure	Higher risk of failure

4.Repair BIOS Settings

4.1.Introduction to repair BIOS settings

BIOS settings are configuration options that control various aspects of a computer's hardware and software.

If BIOS settings are incorrect or corrupted, it can lead to a range of problems, such as system instability, boot failures, or hardware incompatibility.

4.2.Reasons to repair BIOS settings

Software damage: Incorrect settings may have been accidentally modified.

Hardware changes: New hardware components may require specific BIOS settings.

Software conflicts: Conflicts with other software can sometimes affect BIOS settings.

- **Firmware updates:** BIOS updates may introduce new settings or change existing ones.

4.3.Key considerations before to repair BIOS Settings

- **Consult documentation:** Refer to your motherboard's manual or online documentation for specific instructions on navigating and modifying BIOS settings.
- **Create a backup:** Before making significant changes to BIOS settings, consider creating a backup of your current configuration.
- **Seek assistance:** If you're unsure about how to repair BIOS settings, consult a technician or seek online resources for help.

Practical Activity 2.3.2: Performing Computer firmware maintenance

Task:

1: Referring to the **key readings 2.3.2** you are requested to perform the following task.

You have a computer that is experiencing running slow and often crashes issues. After diagn osing the issue, you determine that the BIOS is outdated and needs to be updated.

2: Present your final works to your trainer/classmates

3: Ask for clarification where it is necessary.

Key readings 2.3.2

Performing Computer firmware maintenance

1.Steps of BIOS update

1.1.Common steps of updating BIOS

1. **Check for Updates:** Visit the manufacturer's website for your motherboard and look for available BIOS updates.
2. **Download the Update:** Download the latest compatible BIOS update.
3. **Create a Bootable USB Drive (if necessary):** Some BIOS updates require a bootable USB drive. Follow the manufacturer's instructions.
4. **Enter BIOS Setup:** Restart your computer and press the designated key (usually Delete, F2, or F10) to enter BIOS setup.
5. **Locate the Firmware Update Option:** Navigate to the BIOS update section.
6. **Initiate Update:** Select the update option and follow the on-screen instructions.
7. **Monitor Progress:** The update process may take some time. Avoid interrupting it.
8. **Restart:** Your computer will likely restart automatically after the update.

1.2.How to Update Firmware on Mac OS

For the hardware on your Mac to run correctly, the instructions are provided by the firmware. The instructions control many low-level functionalities like thermal, power, and sleep management features.

To improve the reliability of the hardware and to add additional new features to your device, updates to the firmware are essential. New software and including updates to the Firmware of Apple are provided through the app store.

If you are not sure about the current version of your Mac Firmware, you can check the version number.

Suppose the version is outdated and a current update is not available in the app store updates section, then you can download and install the current version manually and automatically, as shown below:

1.3.Automatic Update

- **Steps To run the update automatically**

1. From the drop-down menu, click the Apple menu and select “Software Update”. This sends you to the updates section automatically by launching the App Store. If requested for information, the administrator username and password are provided.

2. In the update section click the “More” button next to any OS update package and read the update description to see if it has the latest Firmware.

3. Select the “Update” button next to the options containing the firmware updates. To update all available software, click the “Update All” button. The administrator password and username are provided again. The update of Firmware on Mac OS are done automatically.

1.4.Manual Update

- **Steps to run the update manually**

1. Click the Apple menu, and from the drop-down menu, select “About this Mac”.

2. Click the button “More Info” and select the “System Report” button.

3. In the sidebar, select the “Hardware” option, and in the “Model Identifier” and “Boot ROM version” sections, note down the information. The Boot 65 ROM version information refers to the EFI (Extensible Firmware Interface) Firmware version.

4. On the Apple support website, check the available Firmware updates table to determine if the EFI firmware new version is needed. Click the link to download the firmware if the number for your Boot ROM version is earlier than the one listed on the website for your Mac.

5. When it finishes downloading, double click the installation package and update your Mac firmware; follow the prompts in the installer.

6. The “Shutdown” button is clicked. Hold down the power button until the power indicator light blinks after the computer shuts down. The Apple logo display and a long tone sound are heard with a progress bar indicating the update progress after releasing the power button.

The computer is restarted and displays the message that the update is complete.

1.5.How to Update Firmware on Windows

When your computer gets an update, Microsoft has been installing drivers for your device.

By going to Computer Management, a user can update the system firmware manually. Also, some computer models may need to go to their support page and manually install the firmware.

- **Steps to Update Firmware on Windows**

1. Go to Computer Management by pressing Windows key+X. Select the computer management. It can also be done by right clicking the Windows Icon and then selecting Computer Management.

2. Select Device Manager. On the right side, go to the Firmware option. If you do not find this, then your computer model is old, and you have to do the update process manually.

Then Right-click on System Firmware> Select Update driver.

3. Then select the option Search automatically for updated driver software.

4. Now the windows will download automatically and search the Firmware for you, then finish the install and restart your computer.

5. You should now see the new firmware version and model of your computer after the firmware update.

Firmware is a type of software that is embedded directly in a piece of hardware to make the hardware work as intended. Firmware is programmed by the manufacturer and is installed on a digital device right in the factory. All computing devices have firmware.

Firmware microcode comes in various complexities and can be found in simple digital devices, like keyboards and more complex devices like connected vehicles. When a device is powered on, firmware sends instructions to the device's processor to execute.

If the device is as simple as a keyboard, the firmware continues to execute as there is no software to replace it. However, in more complex devices, such as PCs, laptops and tablets, multiple firmware sets interact to achieve a common goal; load the operating system.

Without firmware, the most basic digital devices will not function. That is why firmware is often stored on a Read-Only Memory (ROM) chip, ensuring it does not get erased by accident, while remaining as close as possible to the metal of the device.

Regardless of the type of device, firmware can only work with a basic or low level, binary language known as machine language. While the firmware's code could be written in a high level language for ease and versatility, it needs to be translated into a low level language before getting etched into the device.

2.Steps of BIOS upgrade

2.1.Common steps of updating BIOS

1. **Check Compatibility:** Ensure your hardware and operating system are compatible with UEFI.
2. **Obtain UEFI Firmware:** Download the UEFI firmware update from the motherboard manufacturer.
3. **Create a Bootable USB Drive:** Follow the manufacturer's instructions.
4. **Enter BIOS Setup:** Access BIOS setup as usual.
5. **Locate UEFI Update Option:** Look for a "UEFI BIOS Update" or similar option.
6. **Initiate Upgrade:** Follow the on-screen instructions.

2.2.Steps of Repairing BIOS Settings

1. **Enter BIOS Setup:** Access BIOS setup as described above.
2. **Identify Incorrect Settings:** Review BIOS settings and compare them to the manufacturer's recommended settings or default values.
3. **Correct Settings:** Make necessary adjustments to restore correct settings.
4. **Save and Exit:** Save the changes and exit BIOS setup.

Note: Always refer to the specific instructions provided by your motherboard manufacturer for the exact steps and precautions. It's also recommended to create a backup of your important data before making any significant changes to BIOS settings.

Points to Remember

- **BIOS (Basic Input/output System)** is a crucial piece of firmware that controls the essential functions of a computer.
- **Update BIOS:** A BIOS update typically involves replacing the existing firmware with a newer version. This can introduce new features, improve stability, or fix known issues.
- **Upgrade BIOS:** While the terms "update" and "upgrade" are often used interchangeably in the context of BIOS, an upgrade might imply a more significant change, such as transitioning from a Legacy BIOS to a UEFI BIOS.
- **Repair BIOS Settings:** This involves correcting incorrect or problematic BIOS settings that may be causing issues.

➢ **Steps of upgrading BIOS**

- Check Compatibility
- Obtain UEFI Firmware
- Create a Bootable USB Drive
- Enter BIOS Setup
- Locate UEFI Update Option
- Initiate Upgrade

Application of learning 2.3.

MILLO Technology Company has computers that are experiencing frequent booting failure. Y ou are hired by this company to solve this issue, you have a task of upgrading the firmware o n those computers.

Learning outcome 2 end assessment

Theoretical assessment

1. **Choose the correct answer by circling the letter corresponding to best answer:**

A. What is the BIOS responsible for during the computer startup process?

A) Loading the operating system
B) Controlling hardware initialization
C) Managing network connections
D) Running security checks

B. What is normally the next step in the boot up process after the BIOS message appears on the monitor?

A) The keyboard lights should flash
B) A memory test should be visible on the monitor
C) The hard disk drive access light should come on briefly
D) The operating system (OS) loads into memory and user interface appears

C. What is the first job the Basic Input Output System (BIOS) does at start-up

A) Run memory byte count
B) Test for parity errors
C) Load instructions to RAM
D) Run the power-on-self-test

D. What is a form of firmware that contains the computer's startup instructions?

A)BIOS
B)CMOS
C)Cache

D)EEPROM

E. What component initializes communication with all hardware devices and sends a message if a keyboard or mouse is not found?

A)BIOS

B)CMOS

C) Cache

D) EEPROM

2. **Answer by True if the statement is correct otherwise by False:**

A. The BIOS can be accessed and modified directly through the operating system's graphical user interface.

B. BIOS is a high-level software because it directly controls the way hardware components work.

C. Setting the processor to work at a very high frequency can make it overheat.

D. The BIOS runs after the operating system.

E. CMOS is the memory chip that holds the hardware settings of the computer.

3. Match the following BIOS functions to their descriptions:

BIOS functions	**Descriptions**
a) POST (Power-On Self-Test)	1) Sets the sequence in which devices are checked for bootable media.
b) Boot order configuration	2) Performs initial testing of the system's hardware components.
c) Hardware initialization	3) Loads new firmware to update the BIOS.
d) BIOS update	4) Prepares the system hardware for booting the operating system.

Practical assessment

You have a smartwatch that is experiencing battery drain issues and occasional freezes. After troubleshooting the device and checking for software updates on your smartphone, you suspect that the smartwatch's firmware may need to be updated. Perform this firmware update.

END

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ubuntu


Windows Server


Mac OS


Linux


MS
DOS

Indicative contents
3.1 Description of Operating system
3.2 Specification of software and hardware compatibility
3.3 Preparation of OS installation
3.4 Performing OS installation

Key Competencies for Learning Outcome 3: Deploy Operating system

Knowledge	Skills	Attitudes
• Description of operating system • Identification of software and hardware compatibility	• Installing operating system	• Being Attention • Being Patience and Perseverance • Being Adaptability • Being Collaboration • Having Commitment

Duration: 30hrs

Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly operating system according to the computer hardware compatibility.
2. Prepare properly operating system according to the installation requirement
3. Install successfully operating system based on functionalities.
4. Customize properly operating system according to user preferences.

Resources

Equipment	Tools	Materials
• Computer • Projector • UPS • HDD/SSD Duplicator	• Operating system • storages devices • OS image creation software (rufus, imgburn, power ISO)	• internet bundles

Indicative content 3.1: Description of Operating system

Duration: 10 hrs

Theoretical Activity 3.1.1: Description of operating system

Tasks:

1: Read the key reading **3.1.1.** And Answer the following question

i. What is operating? System and its function
ii. Explain the categories of OS?
iii. Identify the parts of operating system?

2. Provide the answers for the asked questions and write them on flipchart/papers.

3: Present the findings/answers to the whole class.

4: For more clarification, read the **key readings 3.1.1**.

5: In addition, ask questions where necessary.

Key readings 3.1.1.: **Description of operating system**

1.Introduction to Operating system

1.1. Definition

An Operating System (OS) is an interface between a computer user and computer hardware. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

1.2. Functions Operating System

1.2.1. Process Management

- **Process Creation and Termination**: The OS manages the lifecycle of processes, including starting and terminating processes.
- **Multitasking/Multiprocessing**: It allows multiple processes to run simultaneously through multitasking or multiprocessing.
- **Process Scheduling**: The OS determines the order in which processes are executed using scheduling algorithms like Round Robin, First-Come-First-Served (FCFS), etc.
- **Synchronization and Communication**: It manages process synchronization and facilitates inter-process communication (IPC).

1.2.2. Memory Management

- **Memory Allocation**: The OS allocates memory to processes and deallocates it when it's no longer needed.
- **Virtual Memory**: It allows programs to use more memory than physically available through virtual memory, enhancing the efficiency of memory usage.
- **Memory Protection**: The OS protects the memory space of different processes, preventing one process from accessing another's memory.

1.2.3. File System Management

- **File Creation and Deletion**: The OS enables users to create, modify, and delete files.
- **Directory Management**: It organizes files into directories (folders) and manages their hierarchy.
- **File Access and Permissions**: It controls how files are accessed, including reading, writing, and executing, and sets permissions for users or groups.
- **Storage Management**: The OS manages the storage of data on devices like hard drives, SSDs, etc.

1.2.4. Device Management

- **Device Communication**: The OS communicates with hardware devices such as printers, disks, and display devices.
- **Device Drivers**: It uses drivers to act as a translator between the hardware and the OS.
- **I/O Management**: The OS manages input/output operations between the system and peripherals.

1.2.5. Security and Access Control

- **User Authentication**: The OS authenticates users through passwords, biometric data, etc.
- **Access Control**: It sets policies on who can access resources like files and devices.
- **Protection against Malware**: The OS provides mechanisms to protect the system from malicious software.

1.2.6. User Interface Management

- **Command-Line Interface (CLI)**: Some OSs offer a text-based interface for users to interact with the system.

Graphical User Interface (GUI): Modern OSs provide graphical interfaces to make interaction easier and more intuitive.

1.2.7. Networking Management

- **Networking Protocols**: The OS manages communication between devices on a network using protocols like TCP/IP.
- **Resource Sharing**: It facilitates sharing of resources such as files, printers, and internet connections over a network.
- **Security in Networking**: The OS manages firewalls and network security features to prevent unauthorized access.

1.3. Categories of OS and their features

1.3.1. Network Operating Systems (NOS)

- **Definition**: Network OS provides features that enable computers in a network to communicate and share resources like files and printers.
- **Features**:
  - Provides network management capabilities.
  - Enables file sharing, device sharing, and remote access.
  - Centralized user management and security.
  - Examples: Novell NetWare, Windows Server, UNIX.

1.3.2. Embedded Operating Systems

- **Definition**: Embedded OS is designed to run on embedded systems, which are specialized devices that are part of larger machines (like IoT devices, medical equipment).
- **Features**:
  - Highly optimized for the specific hardware it runs on.
  - Typically small, efficient, and designed for low-power devices.
  - Limited user interface.
  - Examples: Embedded Linux, FreeRTOS, QNX.

1.3.3.Standalone Operating System

Definition: is an operating system that can function independently on a computer without the need for a network connection or support from a host system. It is typically installed on a single device, allowing it to manage hardware resources and execute software applications directly.

Features:

Self-Contained: A standalone OS can operate independently, providing all necessary services and utilities without relying on other systems.

User-Friendly Interface: Most standalone OSes come with a graphical user interface (GUI) that makes it easier for users to navigate and interact with the system.

Hardware Management: It manages hardware resources such as CPU, memory, storage, and input/output devices, allowing efficient operation of applications.

File Management: Standalone OSes include file management systems that allow users to create, read, write, and organize files and directories.

1.4. Parts of operating system

1.4.1.Kernel

Function: The kernel is the core part of the OS, responsible for managing system resources, including the CPU, memory, and devices. It operates at a low level, interacting directly with the hardware.

Components:

Process Management: Manages the creation, scheduling, and termination of processes.

Memory Management: Handles the allocation and deallocation of memory to processes.

Device Management: Communicates with hardware devices through drivers, managing input/output (I/O) operations.

Interrupt Handling: Manages interrupts, which are signals from hardware or software indicating an event that needs immediate attention.

1.4.2. User Interface (UI)

Function: The user interface allows users to interact with the OS. It can be text-based (CLI) or graphical (GUI), providing different ways for users to control the system.

Components:

GUI Components: Windows, icons, buttons, and menus that provide an intuitive way to interact with the OS (e.g., desktops like Windows, macOS, or Linux's KDE and GNOME).

CLI Components: Command-line interpreters that accept text commands (e.g., Bash, PowerShell).

1.4.3. System Utilities

Function: System utilities are software programs that perform specific tasks to manage, configure, and maintain the computer system.

Examples:

Disk Management Tools: Programs like disk defragmenters, disk checkers, and partition managers.

Task Management Tools: Utilities for monitoring and managing running processes and system performance (e.g., Task Manager in Windows, htop in Linux).

Backup and Recovery Tools: Software for creating backups and restoring data in case of failure (e.g., Time Machine in macOS, Windows Backup).

Security Tools: Antivirus programs, firewalls, and encryption tools to protect the system from threats.

1.4.4. Device Drivers

Function: Device drivers are specialized software components that enable the OS to communicate with hardware devices. They act as translators between the hardware and the OS.

Components:

Input Devices: Drivers for keyboards, mice, scanners, and other input devices.

Output Devices: Drivers for monitors, printers, and other output devices.

Storage Devices: Drivers for hard drives, SSDs, USB drives, and other storage media.

Network Devices: Drivers for network adapters, modems, and other networking hardware.

Points to Remember

- **Operating systems**: is an interface between a computer user and computer hardware. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

  Examples include Windows, Linux, macOS, iOS, and Android.

- **Functions Operating System:**
  - Process Management
  - Memory Management
  - File System Management
  - Device Management
  - Security and Access Control
  - User Interface Management
  - Networking Management
- **Categories of operating systems**: Standalone OS Embedded OS Network OS
- **Parts of operating system:** Kernel**,** User Interface (UI), System Utilities, Device Drivers

Application of learning 3.1.

You work in an IT department, and a colleague complains that their computer is running very slowly when trying to open multiple applications. They also notice that their system crashes frequently when switching between programs. What aspect of the operating system is likely responsible for this, and how does it function to manage resources?

Indicative content 3.2: Specification of software and hardware compatibility

Duration: 5 hrs

Theoretical Activity 3.2.1: Specification of software and hardware compatibility

Tasks:

1: Read the key reading 3.2.1. And answer the following question

i. What you should consider on disk space and memory space when install oper ating system?
ii. Identify processor capacity which is compatible with operating system?
iii. Identify system type with their compatible operating system?

3: Trainees present their findings.

4: Trainees note some key point from expert view

5: Trainees read the key reading 3.2.1, in their trainee's manuals

Key readings 3.2.1.: Identification of software and hardware compatibility:

Software and hardware compatibility refers to the ability of software to function correctly on a specific hardware configuration. Ensuring compatibility is crucial for the performance, stability, and user experience of a system

When installing an operating system (OS), both disk space and memory (RAM) play critical roles in ensuring the system runs efficiently and has the capacity to handle applications, updates, and data storage

1. Disk Space Consideration

1.1. Minimum OS Disk Space Requirements

OS-Specific Requirements: Each operating system has a minimum disk space requirement. For example, Windows 11 requires at least 64 GB, while some Linux distributions might need as little as 10-20 GB.

Future Updates: Allocate extra space for future updates, which can occupy significant disk space over time.

1.2. File System and Partitioning

System Partition: Allocate sufficient space to the system partition (e.g., C: drive on Windows, / or /root on Linux) to hold the OS and essential system files.

File System Overhead: Different file systems (e.g., NTFS, ext4, APFS) have varying levels of overhead, which reduces usable space on the partition. Factor this in when allocating space.

1.3. Application Installation

Default Installation Location: Most applications install on the same drive as the OS by default. Ensure there's enough space for essential applications, including large software like office suites, development environments, or games.

1.4. User Data and Home Directories

User Profiles: User data, including documents, pictures, and videos, is typically stored in user-specific directories on the OS drive. Allocate extra space for this growing data.

Home Directory (Linux/Mac): On Linux and macOS, the /home or /Users directory stores user data. This directory can grow significantly, especially with media files or project data.

1.5. Swap Space or Page File

Page File (Windows): Windows uses a page file for virtual memory, typically located on the system drive. The size of the page file usually depends on the amount of RAM, commonly around 1.5 times the size of your physical RAM.

Swap Partition (Linux): Linux systems often require a swap partition or swap file. The recommended swap size varies but is often equal to the RAM size for systems with 8 GB or less, and slightly less for systems with more RAM.

1.6. Temporary Files and Cache

OS Temporary Files: The OS creates temporary files during installations, updates, and regular operations. Allocate space to accommodate these files.

Browser Cache and Downloads: Web browsers and other applications store cache and downloaded files on the system drive, requiring additional space.

1.7. System Restore and Backups

System Restore Points (Windows): Windows creates system restore points, which can occupy substantial disk space. Ensure enough space is available for these restore points.

Time Machine (macOS): macOS's Time Machine may use disk space for local snapshots if an external backup disk isn't available.

1.8. Disk Performance

SSD vs. HDD: SSDs offer faster read/write speeds, which can significantly improve OS performance, but they often provide less storage capacity than HDDs at the same price point. Consider your need for speed versus storage capacity

2. Memory (RAM) Considerations

2.1. Minimum and Recommended RAM

OS-Specific Requirements: Different operating systems have minimum and recommended RAM requirements. For example, Windows 11 requires at least 4 GB of RAM, while modern versions of macOS typically need 8 GB or more for smooth operation.

Performance Impact: Insufficient RAM can lead to slower performance, as the system may need to rely heavily on virtual memory (swap space), which is much slower than physical RAM.

2.2.Application Memory Requirements

Running Multiple Applications: Consider the memory demands of the applications you plan to run. Applications like web browsers, video editing software, and virtual machines can consume significant RAM.

Heavy-Duty Applications: High-performance applications, such as professional software for video editing, 3D rendering, or gaming, often require 16 GB or more for optimal performance.

2.3. System Responsiveness

Multitasking: The more RAM you have, the better your system can handle multitasking. For example, running multiple applications simultaneously without slowing down.

Background Processes: Operating systems often have many background processes that consume RAM. Having sufficient memory ensures these processes do not affect the system's responsiveness.

2.4.Virtual Memory and Swap Usage

Virtual Memory: Virtual memory allows the system to compensate for low RAM by using disk space as if it were RAM. However, this is much slower than using physical RAM, so it's best to have enough RAM to minimize reliance on virtual memory.

Swap Space: In systems with limited RAM, swap space on the disk is used as overflow memory. However, excessive use of swap space can lead to significant performance degradation.

2.5.RAM Upgradability

Future-Proofing: Consider the upgradability of RAM if you expect to run more demanding applications in the future. Some laptops and desktops allow for easy RAM upgrades, while others do not.

Dual-Channel Memory: Installing RAM in pairs (dual-channel mode) can improve performance compared to using a single memory module.

3.3.6. 64-bit OS for Better RAM Utilization

64-bit vs. 32-bit: A 64-bit OS can utilize more RAM than a 32-bit OS, which is typically limited to around 4 GB of RAM. Ensure you install a 64-bit OS if you have more than 4 GB of RAM to fully utilize it.

2.6. RAM Compatibility

Check Specifications: Ensure the RAM is compatible with your motherboard in terms of type (DDR3, DDR4, DDR5), speed (measured in MHz), and capacity. Also, check for the maximum RAM supported by your motherboard.

Note that:

Disk Space: Ensure there's enough disk space for the OS, applications, user data, updates, and future growth. Consider the type of disk (SSD vs. HDD) and plan for additional features like swap space and virtual machines.

Memory (RAM): Sufficient RAM is crucial for smooth OS operation and handling applications. Consider both the minimum and recommended RAM for the OS, the demands of your applications, and the potential need for future upgrades.

3. Processor capacity

When identifying processor (CPU) capacity that is compatible with an operating system (OS) installation, you need to consider several factors, including the CPU architecture, clock speed, number of cores, and other specific features that the OS requires or can benefit from

3.1. CPU Architecture

32-bit vs. 64-bit: Most modern operating systems require a 64-bit processor (x86_64 or ARM64 architecture). A 32-bit processor (x86) will only be compatible with older or specifically 32-bit versions of an OS.

ARM vs. x86: Some operating systems, like Windows 10/11 and various Linux distributions, are available for both ARM and x86_64 architectures. Ensure that your processor matches the architecture of the OS you plan to install.

3.2. Clock Speed (GHz)

Minimum Clock Speed: Operating systems typically specify a minimum clock speed required for installation. For instance, Windows 11 requires at least a 1 GHz processor with two or more cores.

Performance Consideration: A higher clock speed generally results in better performance, especially for tasks that require strong single-threaded performance. If you plan to use the OS for intensive tasks, consider a processor with a higher clock speed (e.g., 3.0 GHz or more).

3.3. Power Consumption and Thermal Design Power (TDP)

Power Efficiency: If power consumption is a concern (e.g., in a laptop or energy-efficient server), consider the TDP of the processor. A lower TDP often means less power consumption and less heat generation.

Thermal Management: Ensure that your cooling solution is adequate for the processor's TDP to avoid thermal throttling, which can reduce performance.

3.4. Examples of Compatible Processors by OS

Windows 11: Requires at least a 1 GHz dual-core processor with 64-bit support and compatibility with TPM 2.0 and Secure Boot. Examples include Intel Core i3/i5/i7 (8th Gen and later), AMD Ryzen 3/5/7 (2nd Gen and later), and Apple M1/M2 for macOS (ARM architecture).

Linux Distributions: Linux can run on a wide range of processors, from low-power ARM processors (for lightweight distributions) to high-performance x86_64 processors (for more demanding tasks). Examples include Intel Xeon, AMD Ryzen, and ARM Cortex processors.

MacOS: Requires Apple's own M1 or M2 chips or Intel-based processors (only on older macOS versions, as newer versions are moving exclusively to Apple Silicon).

Note that:

To identify a processor that is compatible with an operating system installation:

Ensure it supports the OS architecture (64-bit or ARM).

Check that the processor meets the minimum clock speed and core/thread requirements.

Verify support for specific OS features like virtualization, Secure Boot, and TPM.

Consider future-proofing by selecting a processor that will handle future OS updates and demands.

4.System type

When discussing system types that are compatible with an operating system (OS), we refer to the specific hardware configurations or platforms that can effectively run that OS. Different operating systems have varying requirements, and the system type (e.g., desktop, laptop, server, mobile device) must meet those requirements to ensure smooth performance and functionality.

4.1. Desktop/Laptop (x86/x86_64 Architecture)

Operating Systems Compatible:

Windows 10/11: Most modern desktops and laptops with x86 or x86_64 processors (Intel Core i3/i5/i7/i9, AMD Ryzen) are compatible with Windows 10 and 11. These systems typically support the necessary features like Secure Boot, TPM 2.0, and UEFI firmware required by Windows 11.

Linux Distributions: Desktops and laptops running x86 or x86_64 processors are compatible with a wide range of Linux distributions, including Ubuntu, Fedora, and Debian. Linux is highly adaptable and can run on a variety of hardware, from high-end workstations to older machines.

macOS (Intel-based): Older Mac desktops and laptops with Intel processors are compatible with macOS versions up to macOS Catalina or Big Sur. Apple has since transitioned to its own ARM-based silicon.

System Type Examples:

High-End Workstation: Intel Core i7/i9 or AMD Ryzen 7/9 with 16+ GB RAM, SSD storage, and dedicated GPU for running Windows 11 or Linux distributions with advanced graphics support.

Budget Laptop: Intel Core i3 or AMD Ryzen 3 with 4-8 GB RAM and HDD/SSD storage, suitable for running Windows 10 or lightweight Linux distributions like ubuntu or Linux Mint

4.2. Mobile Devices (ARM Architecture) (Advanced RISC Machine)

Operating Systems Compatible:

IOS/iPadOS: Exclusively compatible with Apple's mobile devices, which use ARM-based processors (A-series and M-series). These devices are optimized to run iOS and iPadOS, designed for touch interfaces and mobile applications.

Android: Compatible with a wide range of ARM-based smartphones and tablets from various manufacturers (e.g., Qualcomm Snapdragon, Samsung Exynos). Android is highly versatile, running on devices with varying hardware configurations.

Windows on ARM: Compatible with certain ARM-based devices, such as the Microsoft Surface Pro X. This version of Windows is designed to run on ARM architecture, offering better battery life and performance in a mobile form factor.

System Type Examples:

Apple iPhone/iPad: ARM-based A-series processors (e.g., A14, A15) for running iOS/iPadOS.

Android Smartphone: ARM-based Snapdragon or Exynos processors for running Android OS.

Windows ARM Laptop: Microsoft Surface Pro X with ARM-based processor (e.g., Microsoft SQ1/SQ2) for running Windows 10/11 on ARM.

4.3. Embedded Systems (ARM/MIPS/Other Architectures)

Operating Systems Compatible:

Linux (Embedded): Many embedded systems, such as routers, IoT devices, and industrial controllers, run customized versions of Linux designed for ARM, MIPS, or other specialized architectures. Examples include OpenWRT for routers and Yocto Project for custom embedded systems.

RTOS (Real-Time Operating Systems): Operating systems like FreeRTOS, VxWorks, or Zephyr are commonly used in embedded systems that require real-time processing, such as automotive systems or medical devices.

Raspberry Pi OS: A Linux-based OS specifically designed for Raspberry Pi, which uses ARM architecture.

System Type Examples:

Raspberry Pi: ARM-based single-board computer for running Raspberry Pi OS or other Linux distributions.

IoT Device: ARM Cortex-M-based microcontroller running a lightweight RTOS or embedded Linux.

4.4. Apple Silicon (ARM Architecture)

Operating Systems Compatible:

MacOS (Apple Silicon): Apple's M1 and M2 chips, based on ARM architecture, are designed to run macOS Big Sur, Monterey, and later versions. These chips provide high performance and power efficiency, optimized for Apple's software ecosystem.

Linux on Apple Silicon: Some Linux distributions, such as Asahi Linux, are being developed to run on Apple Silicon, though support is still maturing.

System Type Examples:

Apple MacBook Air/Pro with M1/M2: ARM-based laptops running macOS Monterey or Ventura, offering high performance for professional applications.

Note to:

When determining if a system type is compatible with an operating system:

Desktop/Laptop (x86/x86_64): Compatible with Windows, most Linux distributions, and older Intel-based macOS.

Server (x86_64/ARM): Compatible with Windows Server, Linux server distributions, and other enterprise OSes.

Mobile Devices (ARM): Compatible with iOS, Android, and Windows on ARM.

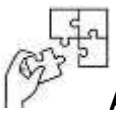
Embedded Systems (ARM/MIPS): Compatible with embedded Linux distributions and real-time operating systems (RTOS).

Apple Silicon (ARM): Compatible with macOS for Apple's M1/M2 chips.

Points to Remember

- **Specification of software and hardware compatibility:**
  - **Disk Space Consideration:** File System and Partitioning, Application Installation**,**

    User Data and Home Directories, Swap Space or Page File, Temporary Files and Cache, System Restore and Backups, Disk Performance,
  - **Memory (RAM) Considerations:** Minimum and Recommended RAM, Application Memory Requirements, System Responsiveness, Virtual Memory and Swap Usage, RAM Upgradability, 64-bit OS for Better RAM Utilization, RAM Compatibilit**y**
  - **Processor capacity**: CPU Architecture, Clock Speed (GHz), Power Consumption and Thermal Design Power (TDP), Examples of Compatible Processors by OS,
  - **System type:** Desktop/Laptop (x86/x86_64 Architecture), Mobile Devices (ARM Architecture), Embedded Systems (ARM/MIPS/Other Architectures), Apple Silicon (ARM Architecture**)**



Application of learning 3.2.

XYZ organization is planning to roll out a new graphic design software that requires at least 8GB of RAM, a dedicated GPU with 2GB VRAM, and Windows 11 for optimal performance. However, some employees are still using machines with 4GB of RAM and integrated graphics, running on Windows 10. As a computer system and architecture technician,

How would you assess the compatibility of the current hardware and software across all systems, and what would your recommendation be for those machines that do not meet the minimum requirements?

Indicative content 3.3: Preparation of OS installation

Duration: 8 hrs

Practical Activity 3.3.1: Preparing OS installation

Tasks:

1: As a technician for a small business that recently acquired ten new desktop computers for its employees, you are tasked with preparing an operating system for the installation process.

2: Read the key readings 3.3.1 about the preparation of OS installation

3: By following the steps from key reading, perform the given task
4: Present the work to the whole class.
5: In addition, ask questions where necessary

Key readings 3.3.1: Preparing OS installation

1. Preparation for OS installation involves several critical steps to ensure the process is successful and that the operating system functions smoothly after installation.

1.1. Creation of OS Image

Creating an OS image involves several steps, which can vary depending on the operating system you're working with:

Prepare Your Environment

Hardware Requirements: Ensure you have the necessary hardware to build and test the OS image.

Software Requirements: Install required tools, such as virtual machines, disk imaging software, and any dependencies needed for the OS.

Choose an OS and Version

Decide which operating system and version you want to create an image of.

Install the OS

Install on a Virtual Machine or Physical Machine: Start with a clean installation of the OS on a virtual machine (like VirtualBox or VMware) or on a physical machine.

Configure the OS

System Settings: Adjust system settings, configure network settings, install updates, and add necessary software.

Customization: Install and configure any additional applications or tools you need in your image.

Clean Up

Remove Temporary Files: Delete any unnecessary files or temporary data.

Remove Personal Data: Ensure that the image does not contain any personal or sensitive data.

Create the Image

Disk Imaging Tools: Use a disk imaging tool (such as Clonezilla, Acronis, or Macrium Reflect) to capture the entire disk or partition as an image file.

Create ISO File: For certain OS types, you might need to create an ISO file instead of a disk image. Tools like mkisofs or genisoimage can help with this.

Test the Image

Deploy on a Virtual Machine: Test the image by deploying it to a virtual machine to ensure it boots correctly and functions as expected.

Test on Physical Hardware: If needed, test the image on physical hardware to verify compatibility.

Distribute and Deploy

Prepare for Distribution: Once you're satisfied with the image, you can distribute it to other systems or users.

Deployment: Deploy the image using tools like PXE boot or imaging software, depending on your setup.

Maintain the Image

Updates: Regularly update the image to include new patches, software updates, and configurations as needed.

If you have a specific operating system or tool in mind, let me know, and I can provide more tailored instructions!

1.2.Creation of a bootable media

Creating a bootable media for an operating system (OS) involves preparing a USB drive, DVD, or other storage device to contain the OS installation files in a format that a computer can boot from. This is an essential step for installing an OS on a system.

Steps of how to create bootable media for various operating systems.

Choose the Operating System

Windows: Windows 10, Windows 11, or any other version.

Linux: Ubuntu, Fedora, Debian, etc.

MacOS: macOS installers like Catalina, Big Sur, or Monterey.

Download the OS Image

Official Website: Download the ISO file or disk image from the official website of the OS.

Windows: You can download the ISO file from the Microsoft website or use the Media Creation Tool.

Linux: Visit the distribution's official site (e.g., ubuntu.com, fedora.org) and download the ISO.

MacOS: Download the installer from the Mac App Store or from Apple's official site if you're creating the bootable media from a Mac.

Select a Suitable Storage Device

USB Drive: A USB flash drive is the most common choice. Ensure it has enough storage space (usually at least 8 GB) and that all data on it can be erased.

DVD: Less common nowadays but can be used if your system has a DVD drive.

External SSD/HDD: In some cases, especially for larger installations or live environments, you might use an external SSD or HDD.

Prepare the Storage Device

Format the USB Drive: The USB drive should be formatted properly before creating the bootable media.

File System: Use FAT32 for maximum compatibility. NTFS might be required for larger files (over 4 GB), but FAT32 is usually the default.

Partition Scheme: Choose MBR (Master Boot Record) for BIOS/Legacy boot or GPT (GUID Partition Table) for UEFI boot.

Use a Tool to Create Bootable Media

Several tools can be used to create bootable media, depending on the OS:

For Windows:

Rufus:

Step 1: Download and launch Rufus.

Step 2: Insert your USB drive.

Step 3: Select the ISO file by clicking on "SELECT."

Step 4: Configure the settings:

Partition scheme: MBR for BIOS or GPT for UEFI.

File system: FAT32 for UEFI or NTFS for BIOS.

Step 5: Click "START" to create the bootable USB.

Points to Remember

- **Preparation for OS installation** involves several critical steps to ensure the process is successful and that the operating system functions smoothly after installation.
- **Steps of how to create OS Image:** Prepare Your Environment, Choose an OS and Version, Install the OS, Configure the OS, Clean Up, Create the Image, Test the Image, Distribute and Deploy, Maintain the Image.
- **Steps of how to create bootable media for various operating systems.** Choose the Operating System, Download the OS Image, Select a Suitable Storage Device, Prepare the Storage Device, Use a Tool to Create Bootable Media.

Application of learning 3.3.

QT Company Ltd are need to install Linux on multiple machines. To streamline the process, you decide to create a custom Linux OS image with pre-installed software. Additionally, you need to create a bootable USB drive. As computers system and architecture technician, what are the steps to create the OS image and bootable media?

Indicative Indicative content 3.4: Performing OS installation

Duration: 5 hrs

Theoretical Activity 3.4.1: Installing Operating system

Tasks:

1: Read the **Key reading 3.4.1** and answer the following questions

i. Describe the steps of OS installation?

ii. Explain basic parameter's setting?

iii. How to perform disk cloning for any OS?

2: Provide the answers for the asked questions and write them on flipchart/papers.

3: Present the findings/answers to the whole class.

4: For more clarification, read the **key readings 3.4.1**.

5: In addition, ask questions where necessary.

Key readings 3.4.1: Installing Operating system

1. OS Installation process

The OS (Operating System) installation process involves several steps to set up a new operating system on a computer. The process varies slightly depending on the OS being installed, but the general steps are quite similar.

1.1. Steps of Installing Operating System

- **Preparation**

Backup Data: Before installing a new OS, it's crucial to back up any important data, as the process often involves formatting the drive, which will erase all existing data.

Download OS Installation Media: Obtain the OS installation file. This could be a bootable USB drive, DVD, or ISO file. For example, you might download Windows from Microsoft's website, or Linux distributions like Ubuntu from their official sites.

Check System Requirements: Ensure your hardware meets the OS's minimum requirements (CPU, RAM, storage, etc.).

- **Create Bootable Media**

Use a Tool: If you have an ISO file, you'll need to create a bootable USB drive or DVD. Tools like Rufus (for Windows) or Etcher (cross-platform) are commonly used to create bootable media.

Format the Drive: Make sure the USB drive or DVD is formatted correctly to hold the installation files.

- **Boot from Installation Media**

Insert Media: Insert the bootable USB drive or DVD into the computer.

Access BIOS/UEFI: Restart the computer and access the BIOS/UEFI settings (usually by pressing a key like F2, F10, DEL, or ESC during startup).

Change Boot Order: Set the boot priority to start from the USB drive or DVD.

Save and Exit: Save the changes and restart the computer.

- **Begin Installation**

Start Installer: The computer will boot from the installation media, and the OS installer will start.

Select Language and Region: Choose your preferred language, region, and keyboard layout.

Choose Installation Type: You might have options like upgrading an existing OS, performing a clean installation, or dual-booting (installing the OS alongside an existing one).

- **Partitioning the Disk**

Select Drive: Choose the drive where you want to install the OS.

Partitioning: You can create, delete, or format partitions on the drive. For a clean installation, you might format the entire drive.

Select Partition: Choose the partition where the OS will be installed.

- **Install the OS**

Copying Files: The installer will copy the necessary files to your hard drive. This can take some time.

Configure Settings: During or after installation, you'll be prompted to configure settings like time zone, network, and user account details.

- **Final Setup**

Remove Installation Media: Once the installation is complete, the computer will restart. Remove the installation media (USB/DVD) to avoid booting from it again.

First Boot: The OS will boot up for the first time. You may need to go through some initial setup steps, such as creating a user account, setting a password, and configuring basic preferences.

Install Updates: After the initial setup, check for any system updates or drivers that need to be installed.

Install Software: Install necessary applications and restore your data from backups if needed.

- **Post-Installation**

Driver Installation: Ensure all hardware components (e.g., graphics card, network adapter) are recognized and have the correct drivers installed.

Security Setup: Install antivirus software, enable firewalls, and configure other security settings.

Personalization: Adjust system settings, themes, and other preferences to your liking.

1.2.Setting basics parameters

During the OS installation process, you will encounter several basic settings that you need to configure. These settings are crucial as they determine the behaviour of your operating system and its compatibility with your hardware and network environment.

1.2.1.Create user accounts

Creating user accounts during OS installation or afterward is a crucial step in setting up your operating system. User accounts allow multiple people to use the same computer while keeping their files, settings, and preferences separate. They also play a key role in security by managing access rights and permissions. Here's a detailed overview:

1.2.2.Types of User Accounts

- **Administrator Account**

Privileges: This account type has full control over the system. It can install software, change system settings, manage other user accounts, and access all files on the computer.

Usage: Typically, the first account created during OS installation is an administrator account. It's crucial to protect this account with a strong password since it has the most privileges.

- **Standard User Account**

Privileges: Standard user accounts have limited access. They can run applications, change their own settings, and save files in their own user folders but cannot make system-wide changes or install certain software.

Usage: Ideal for daily use or for other users who don't need administrative access, as it reduces the risk of accidental changes to the system.

- **Guest Account**

Privileges: A guest account provides temporary access with very limited privileges. It cannot install software, change system settings, or access other users' files.

Usage: Useful for occasional users or visitors who need access to the computer without altering its configuration or accessing sensitive data.

- **Child/Family Account**

Privileges: These accounts often come with parental controls, limiting access to certain websites, applications, and features. They can also have time limits on usage.

Usage: Designed for children, these accounts help parents monitor and control what their children can do on the computer.

1.2..3.Creating User Accounts during OS Installation

- **Initial Account Creation**

Username and Password: During the installation process, you'll typically be prompted to create an initial user account. You'll set a username and a strong password.

Account Type: This account is usually set as an administrator by default, as it's the first account on the system.

Security Options: You may also set up security questions, enable two-factor authentication (if supported), or choose a PIN instead of a password.

- **Local vs. Online/Cloud Accounts**

Local Account: A local account is stored on the computer and is independent of any online services. It's suitable for users who prefer not to sync their settings or data across devices.

Online/Cloud Account: Many operating systems (like Windows or macOS) offer the option to create an account linked to an online service (e.g., Microsoft account, Apple ID). This allows for synchronization of settings, files, and preferences across multiple devices and enables additional features like cloud storage.

Email Integration: If creating an online account, you'll typically need to provide an email address, which will be used for account recovery and notifications.

1.3.Install OS updates

The **Install OS Updates** setting is crucial for maintaining the security, stability, and performance of your operating system. This setting determines how and when the operating system downloads and installs updates. These updates can include security patches, bug fixes, driver updates, and new features. Here's a detailed explanation of this setting:

- **Automatic Updates**

Enable Automatic Updates: The OS will automatically download and install updates as they become available, often during idle times or scheduled maintenance windows. This is the most common and recommended setting for most users because it ensures that your system is always up-to-date with the latest security patches and improvements.

Scheduled Installation: You can set a specific time for updates to be installed, often during off-hours when the computer is not in use. This minimizes disruption and ensures that updates are applied regularly.

- **Manual Updates**

Notify to Download and Install: The OS will notify you when updates are available, allowing you to choose when to download and install them. This gives you more control over the update process, but it requires you to be proactive in managing updates.

Check for Updates Manually: You can manually check for updates at any time. This option is useful for users who prefer to control exactly when updates are applied or for those with limited internet bandwidth who want to avoid automatic downloads.

1.4.Install needed drivers

When installing an operating system (OS), certain drivers are crucial to ensure the system can be installed and that basic hardware functions properly. Here’s a list of the most important drivers needed during the OS installation process:

- **Storage Controller Drivers**

Purpose: These drivers allow the OS to recognize and interact with your storage devices, such as hard drives, SSDs, and RAID arrays.

Importance: Without these drivers, the OS may not be able to detect your storage devices, preventing installation.

When Needed: If the OS installer cannot detect your hard drive or SSD, you'll need to load the storage controller drivers during installation. This is particularly common with RAID setups or NVMe drives on older systems.

- **Chipset Drivers**

Purpose: Chipset drivers manage communication between the CPU, memory, and other components on the motherboard.

Importance: While these drivers are typically installed after the OS installation, they are critical for ensuring that the system runs efficiently and that all motherboard features are fully supported.

When Needed: These can generally wait until after the OS is installed, but they should be installed early on to ensure system stability.

- **Network Drivers (Ethernet/Wi-Fi)**

Purpose: Network drivers enable your system to connect to the internet via wired (Ethernet) or wireless (Wi-Fi) connections.

Importance: Essential for downloading updates, additional drivers, and software during or immediately after OS installation.

When Needed: Often needed during the installation process if you plan to download updates or additional drivers directly from the internet.

- **USB Drivers**

Purpose: USB drivers allow the OS to recognize and use USB ports for peripherals like keyboards, mice, and external drives.

Importance: Necessary for using USB-connected devices during installation, such as USB flash drives that contain the OS installer.

When Needed: Basic USB functionality is usually included in the OS installation, but specific drivers may be needed for USB 3.x or USB-C ports, particularly on newer hardware.

- **Basic Display Drivers**

Purpose: Display drivers allow the OS to use your graphics card (GPU) or integrated graphics for outputting video to your monitor.

Importance: While basic display functionality is usually provided by default drivers during installation, specific drivers from the GPU manufacturer are needed for optimal performance and full resolution support.

When Needed: Typically not needed until after the OS installation, but they are important for ensuring proper visual output during and immediately after setup.

- **Input Device Drivers**

Purpose: These drivers enable the use of essential input devices like the keyboard and mouse.

Importance: Without these, you may not be able to interact with the installation interface.

When Needed: Basic support is usually provided by the OS, but advanced features (like additional mouse buttons) may require specific drivers after installation.

- **Firmware/BIOS/UEFI Updates**

Purpose: Ensures that the motherboard and all connected hardware are fully compatible with the OS and perform optimally.

Importance: Sometimes necessary to enable newer hardware features or fix compatibility issues before or during OS installation.

When Needed: Check for updates before installing the OS, especially when using newer hardware with an older motherboard.

Additional Notes:

Windows OS: Windows typically includes a wide range of drivers in its installation media, covering most common hardware. However, specialized or newer hardware might require specific drivers to be loaded manually during installation.

Linux OS: Linux distributions often include a broad set of drivers, but for proprietary hardware like certain Wi-Fi adapters or GPUs, you might need to install specific drivers after the initial OS setup.

MacOS: Drivers are generally bundled with macOS, but if you're installing macOS on non-Apple hardware (Hackintosh), you might need specific kexts (drivers) during installation.

Change Default Settings

Changing default settings during an OS installation can vary depending on the operating system (OS) you're installing. Below are general steps for modifying default settings during the installation of common operating systems like Windows, macOS, and Linux distributions.

Windows OS Installation

Boot from Installation Media:

Insert the installation USB/DVD and boot your computer.

Press the necessary key (like F12, F2, ESC, etc.) to enter the boot menu and select your installation media.

Language, Time, and Keyboard Settings:

The initial setup screen allows you to select your language, time, and keyboard layout.

Custom Installation:

When you reach the "Install Windows" screen, choose the "Custom" option to manually configure settings.

Partition Setup: Here, you can create, delete, and format partitions.

Installation Drive: Select the drive where you want to install Windows.

Customize Settings:

After installation, Windows will prompt you to adjust privacy settings, set up a user account, and configure network settings.

Privacy Settings: Choose which data you want to share with Microsoft.

User Account: Set up a local account or log in with a Microsoft account.

Network: Choose between a public or private network settings.

Windows Updates:

You can choose to download and install updates automatically or set it to ask you first.

macOS Installation

Boot from Installation Media:

Restart your Mac and hold down the Option key to select the installation media.

Select Language:

Choose the language for the installation process.

Disk Utility (Optional):

If needed, open Disk Utility to erase or partition your disk before installation.

Installation Options:

When you begin the installation, you can customize the installation options.

Target Disk: Select the disk where macOS will be installed.

Customize Settings: During the setup, you can choose whether to enable FileVault, set up iCloud, configure privacy settings, and more.

- **User Account**:

Set up a new user account and configure initial settings.

Optimize Power Plan Settings

Optimizing power plan settings can help you balance performance and energy efficiency, especially on laptops. Here's a guide on how to optimize power plan settings for different operating systems:

1.5.Perform disk cloning

Disk cloning is the process of creating an exact copy of a hard drive or SSD, including the operating system, applications, and all files. This can be useful for backing up your system, upgrading to a larger drive, or migrating to a new computer. Here's how to perform disk cloning on different operating systems:

1.5.1.Windows OS

- **Using Third-Party Software**

Choose a Disk Cloning Tool:

Popular options include **Clonezilla**, **Macrium Reflect**, **Acronis True Image**, and **EaseUS Todo Backup**. Some offer free versions with basic features.

- **Install and Launch the Software**:

Download and install the chosen software on your computer. Launch the application to begin the cloning process.

- **Connect the Target Drive**:

Connect the new (target) drive to your computer. This can be done via an external USB enclosure or by connecting it internally.

- **Start the Cloning Process**:

Follow the instructions provided by the software. Typically, you will:

Select the Source Drive: Choose the drive you want to clone (the original drive).

Select the Target Drive: Choose the drive where the clone will be saved.

Start Cloning: Initiate the cloning process. This may take some time depending on the size of the data.

- **Verify the Clone**:

Once cloning is complete, verify the target drive to ensure all data has been copied correctly. You can do this by checking the drive's contents or booting from it if it's intended to be a bootable drive.

- **Using Windows Backup and Restore**

Open Backup and Restore:

Go to **Control Panel > System and Security > Backup and Restore (Windows 7)**.

Create a System Image:

Click **Create a system image** on the left. Choose the destination for the backup (external drive, DVDs, or network location).

Complete the Backup:

Follow the prompts to complete the backup process. This will create an image of your system, but it may not be a direct clone.

macOS

- **Using Disk Utility**

Open Disk Utility:

Go to **Applications > Utilities > Disk Utility**.

Select the Source Drive:

In Disk Utility, select the drive you want to clone (the source).

Create a Disk Image:

Go to **File > New Image > Image from [source drive]**. Choose a location to save the disk image (e.g., an external drive).

Restore the Disk Image:

Connect the target drive and go to **Restore** in Disk Utility.

Select the disk image you created as the source and the target drive as the destination.

Click **Restore** to clone the disk image to the target drive.

Points to Remember

- **OS Installation process**

The OS (Operating System) installation process involves several steps to set up a new operating system on a computer.

- **Steps of installing operating system:** Preparation, Create Bootable Media, Boot from Installation Media, Begin Installation, Partitioning the Disk, Install the OS, Final Setup, Post-Installation.
- **Basic parameters** include creating user accounts, installing updates and drivers, changing default settings, and optimizing power plans.
- **Disk cloning** creates an exact copy of a drive, useful for backups, upgrades, or migration.

Practical Activity 3.4.2: Performing OS installation

Task:

1: Refer to the previous theoretical actives3.4.1 Read again, key reading 3.4.1. And perform the task below

You are a technician working for a small business that has recently purchased ten new desktop computers for its employees. The company needs these computers set up with the latest operating system, configured with specific settings, and prepared for disk cloning to ensure all systems are identical

2. Provide the answers for the asked questions and write them on flipchart/papers.

3: Present the findings/answers to the whole class.

4: For more clarification, read the **key readings 3.4.1**.

5: In addition, ask questions where necessary.

Points to Remember

- **Operating System Installation** involves preparing the computer, creating bootable media, booting from the installation media, partitioning the disk, installing the OS, and finalizing the setup.
- **Basic parameters** include creating user accounts, installing updates and drivers, changing default settings, and optimizing power plans.
- **Disk cloning** creates an exact copy of a drive, useful for backups, upgrades, or migration.

Application of learning 3.4.

You are a technician at a mid-sized company that is transitioning to a new software application that will be used across all departments. The company has purchased 50 new computers for this purpose, and your task is to ensure that each machine is set up with the necessary operating system, configured with the appropriate settings, and prepared for the deployment of the new software application

Learning outcome 3 end assessment

Written assessment

Multiple Choice Questions

Q1: Which component is responsible for processing instructions and data?

A. CPU

B. RAM

C. GPU

D. Motherboard

Q2: Which of the following is the primary role of an operating system?

A) Compiling code into machine language
B) managing hardware resources and providing an interface for user interaction
C) Designing applications for specific tasks
D) performing data analysis for business intelligence

Q3: What is the core component of an operating system that manages system resources and communication between hardware and software?

A)Kernel
B)Driver
C)BIOS
D) Shell

Q4: Which of the following is a feature of a multitasking operating system?

A) It can execute multiple programs at the same time.
B) It is designed to operate on a single program at a time.
C) It can only run programs in the background.
D) It can run without a user interface.

Q5: Which type of operating system is designed to serve multiple users simultaneously over a network?

A)Real-time Operating System (RTOS)
B)Single-user Operating System
C)Network Operating System (NOS)
D) Distributed Operating System

True and false question

Q1. Before installing a new operating system, it is essential to back up all important data to prevent data loss.

Q2.During an OS installation, formatting the hard drive is always mandatory.

Q3. You can only install an operating system from a physical disc such as a DVD or CD.

Fill-in-the-Blank Questions

Q1.The minimum amount of _____ required for running a specific software ensures that the computer can load and execute the program without performance issues.

Q2.To check if a particular software is compatible with your system, you must verify that the _____ matches the operating system's architecture (e.g., 32-bit or 64-bit).

Q.3A _____ is a piece of software that allows the operating system to communicate with a hardware component, ensuring compatibility and proper functionality.

Q.4For a game to run smoothly, the _____ should meet or exceed the minimum requirements specified, including processing power, memory, and graphics capabilities.

Practical assessment

Question1.

You have successfully booted from a USB containing the **Windows 11** installation media. During the installation process, you're presented with the option to choose a partition. The computer has a single **500GB SSD** with a previous Windows installation that you no longer need. How would you proceed with the installation?

.

END

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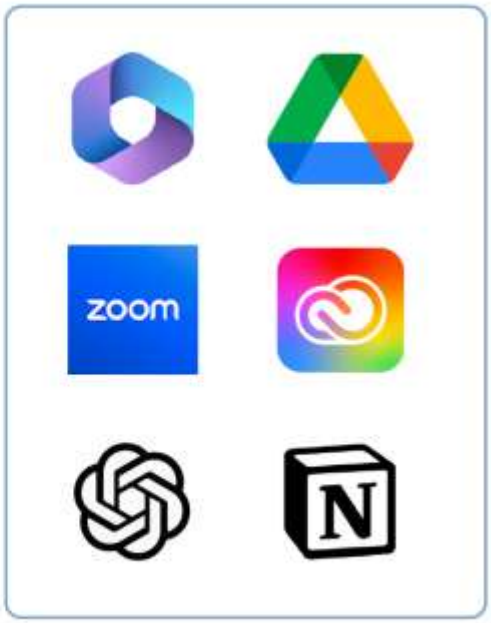
Educational software



Productivity tools

Research & development tools

Web browsers & operating systems

Indicative contents

4.1. Identification of Application software

4.2. Specification of software compatibility and hardware compatibility

4.3. Implement installation procedures

Key Competencies for Learning Outcome 4: Install application software

Knowledge	Skills	Attitudes
• Identification of Application software • Description of software compatibility • Identification of hardware compatibility	• Performing application software installation • Implementing installation procedures	• Being responsible • Having curiosity • Having Patience • Being able to follow instructions.

Duration: 10 hrs

Learning outcome 4 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify properly application software based on system user requirement.

2. Select correctly application software based on system requirement.

3. Install successfully application software according to the functionality.

 **Resources**

Equipment	Tools	Materials
• Computer • Projector • UPS	• Application software • Storages devices	• Internet bundles

Indicative content 4.1: Identification of Application software

Duration: 4 hrs

Theoretical Activity 4.1.1: Description of Application software

Tasks:

1: Answer the following question:

i. Describe Application software.

2: Trainees present their findings

3: Trainees follow expert view

4. Trainees are reading the key reading 4.1.1 in trainee's manuals.

Key readings 4.1.1.: Description of Application software

1. Application software

Application software is end-user software or apps, is a type of computer software designed to perform specific tasks for users. Unlike system software, which manages the computer's resources, application software focuses on providing services or tools for users.

1.1 Definition of application software

An **application program** is a type of computer program that performs a specific personal, educational, and business function.

Each application is designed to assist end-users in accomplishing a variety of tasks, which may be related to productivity, creativity, or communication

1.2 **Key Characteristics of Application Software**

- **User-Friendly Interface:** Application software is designed to be intuitive and easy to use, with a graphical interface that allows users to interact with the program.

- **User-focused:** Designed to meet the needs and requirements of users.
- **Task-specific:** Performs specific tasks or functions, such as word processing, image editing, or data analysis.
- **Specific Functions:** Each application software has a specific purpose, such as word processing, spreadsheet creation, image editing, or web browsing.
- **Interacts with Hardware and OS:** Uses the computer's hardware and operating system to perform its tasks
- **Variety of Types:** Includes productivity software, graphics software, multimedia software, specialized software, and more.

1.3 Functions of Application Software

Application software performs a wide range of functions, depending on its specific purpose.

- **Productivity:** Create, edit, and manage documents, spreadsheets, presentations, and emails.
- **Multimedia:** Edit images, videos, and audio files; play multimedia content.
- **Business:** Manage finances, customer relationships, inventory, and other business processes.
- **Entertainment:** Provide games, music, movies, and other forms of entertainment.
- **Education:** Teach and learn through interactive lessons, simulations, and quizzes.
- **Communication:** Facilitate communication through email, messaging, and video conferencing.
- **Utilities:** Perform system maintenance, security, and optimization tasks.

1.4.Types of Application Software

● **Application software.** The most common type of software, application software is a computer software package that performs a specific function for a user, or in some cases, for another application. An application can be self-contained, or it can be a group of programs that run the application for the user. Examples of modern applications include office suites, graphics software, databases and database management programs, web

browsers, word processors, software development tools, image editors and communication platforms.

● **System software**. These software programs are designed to run a computer's application programs and hardware. System software coordinates the activities and functions of the hardware and software. In addition, it controls the operations of the computer hardware and provides an environment or platform for all the other types of software to work in. The OS is the best example of system software; it manages all the other computer programs. Other examples of system software include the firmware, computer language translators and system utilities.

● **Driver software.** Also known as device drivers, this software is often considered a type of system software. Device drivers control the devices and peripherals connected to a computer, enabling them to perform their specific tasks. Every device that is connected to a computer needs at least one device driver to function. Examples include software that comes with any nonstandard hardware, including special game controllers, as well as the software that enables standard hardware, such as USB storage devices, keyboards, headphones and printers.

● **Middleware.** The term middleware describes software that mediates between application and system software or between two different kinds of application software. For example, middleware enables Microsoft Windows to talk to Excel and Word. It is also used to send a remote work request from an application in a computer that has one kind of OS, to an application in a computer with a different OS. It also enables newer applications to work with legacy ones.

● **Programming software.** Computer programmers use programming software to write code. Programming software and programming tools enable developers to develop, write, test and debug other software programs. Examples of programming software include assemblers, compilers, debuggers and interpreters

- **Productivity Software**

- **Word processing:** Microsoft Word, Google Docs, LibreOffice Writer
- **Spreadsheets:** Microsoft Excel, Google Sheets, LibreOffice Calc
- **Presentation software:** Microsoft PowerPoint, Google Slides, LibreOffice Impress
- **Database management systems:** MySQL, PostgreSQL, Microsoft Access

- **Graphics and Design Software**

- **Image editing:** Adobe Photoshop, GIMP
- **Vector graphics:** Adobe Illustrator, Inkscape
- **Video editing:** Adobe Premiere Pro, DaVinci Resolve
- **3D modeling:** Blender, Autodesk Maya

- **0Multimedia Software**
  - **Media players:** VLC, Windows Media Player, iTunes
  - **Audio editing:** Audacity, Adobe Audition
  - **Video editing:** Adobe Premiere Pro, Final Cut Pro
- **Specialized Software**

- **Accounting software:** QuickBooks, Sage Intacct
- **Customer relationship management (CRM) software:** Salesforce, HubSpot
- **Enterprise resource planning (ERP) software:** SAP, Oracle
- **Education software:** Moodle, Blackboard
- **Scientific software:** MATLAB, Mathematica

- **Other Categories**

- **Web browsers:** Chrome, Firefox, Safari
- **Games:** Fortnite, Minecraft, The Sims
- **Utilities:** Antivirus, file compression, system optimization

Points to Remember

Application software is a type of computer program that performs a specific personal, educational, and business function. Each application is designed to assist end-users in accomplishing a variety of tasks, which may be related to productivity, creativity, or communication.

Application of learning 4.1.

You need to attend online class and you are supposed to use zoom application software to collaborate with colleagues in studying. How can you do installation of zoom app on a computer?

Indicative content 4.2: Specification of software compatibility and hardware compatibility

Duration: 3 hrs

Theoretical Activity 4.2.1: Description of specification of software compatibility and hardware compatibility.

Tasks:

1: Answer the following question

i. Differentiate software and hardware compatibility specifications.

2: Trainees present their findings

3: Trainees follow expert view and ask them to note the key point.

4: Trainees are reading the key reading 4.2.1 in trainee's manual.

Key readings 4.2.1.: Description of specification of software compatibility and hardware compatibility.

1. Specification of software compatibility and hardware compatibility

1.1. Definition of software and hardware compatibility

Software and hardware compatibility refers to the ability of software applications to function correctly with specific hardware components and operating systems.

This intricate relationship ensures seamless operation and optimal performance.

1.2 Factors Affecting Software Compatibility

- **Operating System:** Different software applications are designed to work with specific operating systems (e.g., Windows, macOS, Linux). The compatibility of the software with the operating system is crucial for proper functioning.

- **Processor:** The processor's speed, architecture, and capabilities can significantly impact software performance. Certain software applications may require specific processor features or minimum clock speeds.
- **Memory:** Sufficient RAM (Random Access Memory) is essential for software to run smoothly. The amount of RAM required can vary depending on the software's complexity and resource demands.
- **Storage:** The type and capacity of storage devices (e.g., HDD, SSD) can affect software performance. Some software applications may require specific storage types or minimum storage capacities.
- **Graphics Card:** For graphics-intensive software, a compatible and powerful graphics card is essential. The graphics card's specifications, such as memory and processing power, can significantly impact performance.
- **Other Hardware Components:** Depending on the software, additional hardware components may be required, such as sound cards, network adapters, or specialized input devices.

1.3 Specifying Compatibility

When choosing software, it's crucial to consider the following:

- **System Requirements:** Check the software manufacturer's recommended system requirements, which typically list the minimum hardware specifications needed for the software to run.
- **Operating System Compatibility:** Ensure the software is compatible with your operating system.
- **Hardware Compatibility:** Verify that your computer's hardware meets the software's requirements.
- **Software Dependencies:** Some software may depend on other software components or libraries. Ensure these dependencies are installed and compatible.

1.4 Troubleshooting Compatibility Issues

If you encounter compatibility problems, try the following:

- **Check System Requirements:** Verify that your hardware meets the minimum requirements for the software.
- **Update Drivers:** Ensure your hardware drivers are up-to-date.
- **Check for Software Updates:** Update the software to the latest version, which might address compatibility issues.
- **Consult Documentation:** Refer to the software's documentation for troubleshooting tips.
- **Contact Support:** If you're still having trouble, contact the software manufacturer's support.

Application of learning 4.2.

A client has a laptop running Windows 10 with an Intel Core i5 processor, 8GB RAM, and a 500GB HDD. They are unable to install a new software application that requires Windows 11, a minimum of 4GB RAM, and a 1TB SSD. What steps would you take to address this compatibility issue and provide solutions to the client?

Indicative content 4.3: Implement installation procedures

Duration: 3 hrs

Theoretical Activity 4.3.1: Description of Application software installation

Tasks:

1: Answer the following question

i. What are the steps of installing a software application?

2: Trainees present their findings

3: Trainees follow expert view and ask them to note the key point.

4: Trainees are reading the key reading 4.3.1 in trainee's manual.

Key readings 4.3.1.:

Description of Application software installation

1. **Definition of application software installation**

Application software installation is the process of copying and configuring software files onto a computer system so that the software can be used.

2. Application software installation key steps

- **Acquiring the Software:** Obtain the software installation package from a trusted source, such as the software manufacturer's website, an app store, or a physical media (e.g., CD, DVD).
- **Running the Installer:** Double-click the installation package to launch the installer program.
- **Following the Instructions:** The installer will guide you through the installation process, prompting you to accept license agreements, choose an installation location, and select features.
- **Extracting and Copying Files:** The installer will extract the software files from the installation package and copy them to the appropriate directories on your computer.

- **Registering the Software:** If required, you may need to register the software using a product key or activation code.
- **Creating Shortcuts:** The installer may create shortcuts on your desktop or in your start menu for easy access to the software.
- **Completing the Installation:** The installer will finish the installation process and may prompt you to restart your computer.

3. Factors Affecting Installation

Several factors can influence the application software installation process:

- **System Requirements:** The software must be compatible with your computer's hardware and operating system.
- **User Privileges:** You may need administrator privileges to install certain software.
- **Internet Connection:** If the software is downloaded from the internet, a stable connection is required.
- **Antivirus Software:** Antivirus software may interfere with the installation process.

4. Troubleshooting Installation Issues

If you encounter problems during the installation process, try the following troubleshooting steps:

- **Check system requirements:** Ensure your computer meets the minimum requirements for the software.
- **Update drivers:** Make sure your hardware drivers are up-to-date.
- **Disable antivirus software temporarily:** Antivirus software can sometimes interfere with installations.
- **Run the installer as administrator:** If prompted, run the installer with administrator privileges.
- **Consult the software documentation:** Refer to the software's documentation for troubleshooting tips and guidance.

Practical Activity 4.3.1: Perform application software Installation Procedures

Tasks:

1: Referring to the **key readings 4.3.1** you are requested to perform the following task.

You recently purchased a new laptop and need to install Microsoft Office. You have the i nstallation media. What steps would you take to successfully install Microsoft Office on y our laptop, ensuring compatibility and proper installation?

2: present your final works to your trainer/classmates

3: Ask for clarification where it is necessary.

Key readings 3.2.1.: Perform application software Installation Procedures

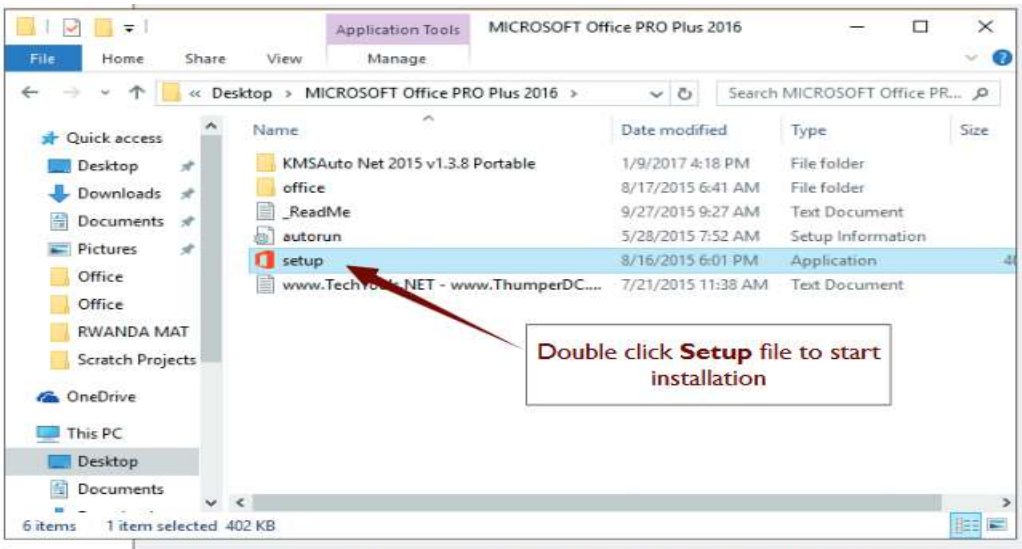
1.1 Install Microsoft (MS) Office 2016 on selected computer(s)

Follow the steps below:

Step 1: Obtain Ms office installation DVD (or download Installation file from the Internet.)

Step 2: Insert the disc in the optical drive (e.g. DVD Drive) the installation disc automatically launches setup wizard. (If the setup wizard doesn't start automatically, open the disk drive or folder for office 2016 and double-click Setup file.

See the picture below.



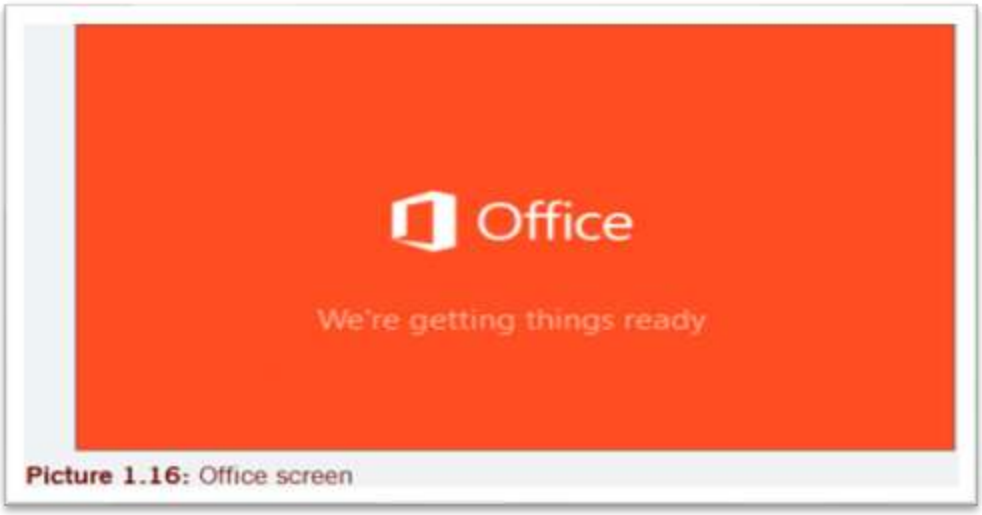
Picture 1.15: File Explorer (Windows Explorer) showing Microsoft Office 2016 folder

When the setup file is double-clicked, it displays the office screen as shown in Picture 1.16.

Remember:

To install application software successfully you must use an Administrator account, without which installation cannot take place. Other types of accounts such as standard

or limited accounts and Guest accounts do not have the privilege to install or uninstall software. If you normally use limited accounts for doing other practical activities, this time you should use an administrator account to install Microsoft office 2016 and other applications.

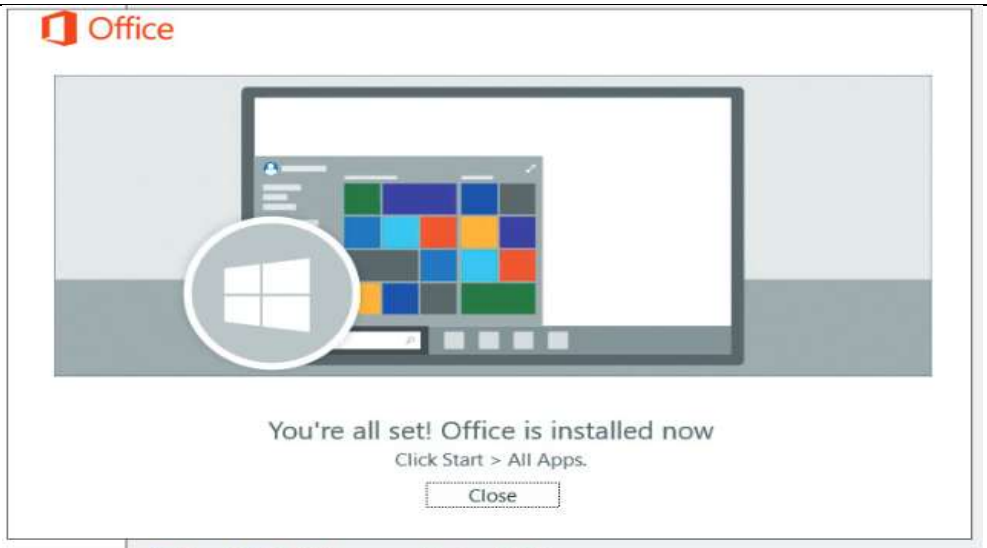


Picture 1.16: Office screen

After a short time, the office installation screen appears to show the status of installation process as shown in picture 1.17.

Picture 1.17: Office 2016 installation status

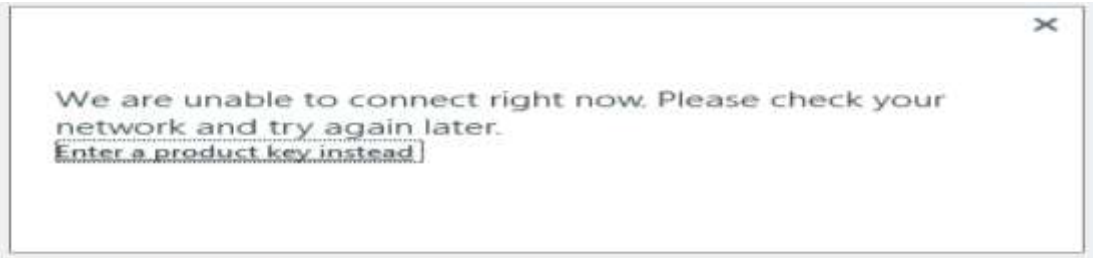
Step 3: Wait as office installs to complete the installation process. Click Close after the installation is complete (see picture 1.18).



Picture 1.18: Office complete installation screen

Step 4: open an office application such as Word 2016. the message as shown in picture 1.20 may display on top of office (Word) 2016 Open back stage screen. In case you purchased a licensed product, close it and will not show again, start using office normally.

If you purchased a non-licensed product, and you have the product key, click on "enter a product key instead" (see picture 1.20).



Picture 1.19: Office connection Error screen

The Product key screen displays. Type in your product key which must be 25 characters and then click on continue.

MS Office 2016 may not require a product key once you purchase a licensed copy.

Note: Product key is a specific software-based key for a computer program and certifies that the copy of the program is original. If you do not have product key, you may fail to use the software installed normally or if the product key is required before installation you may fail to install the software. The location of your product key depends on how you got a copy of the software.

Step 5: Afterwards office installs; click close after installation is complete.

Step 6: If the activation wizard displays, click "*I want to activate the software over the Internet*" and then follow prompts.

1.2 How to install application software (installing skype)

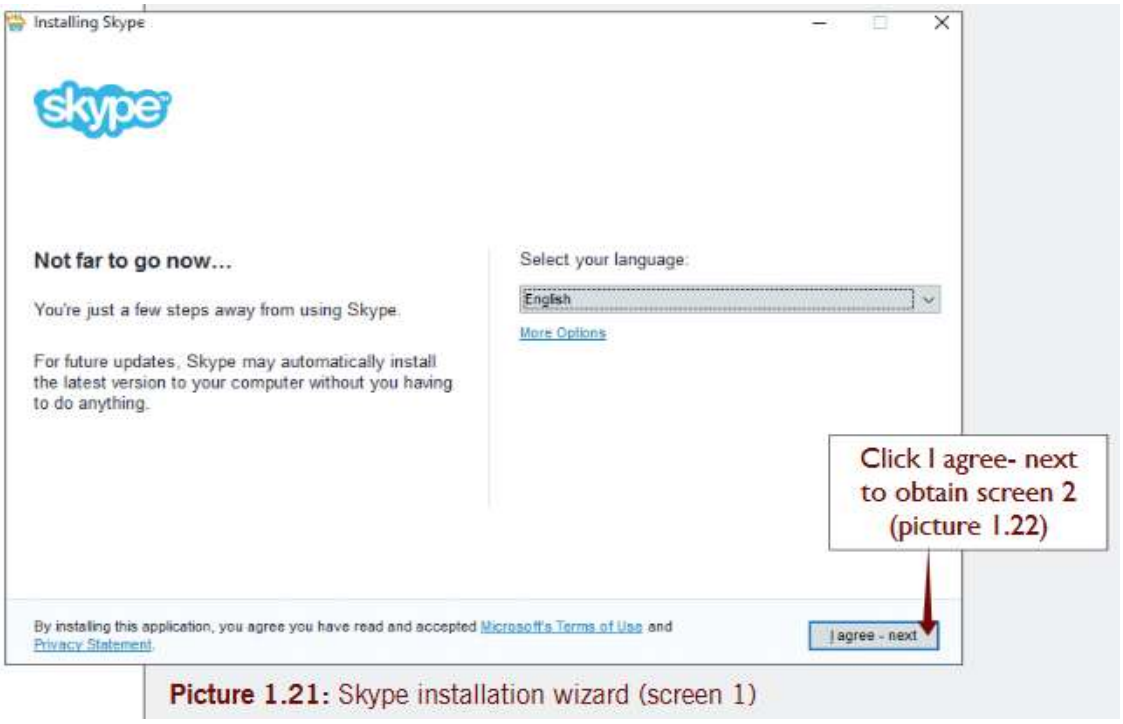
Procedure

Step 1: obtain a disc that contains the software to be installed. If you earlier downloaded the software, then check for the software from the folder where you save on the desktop.

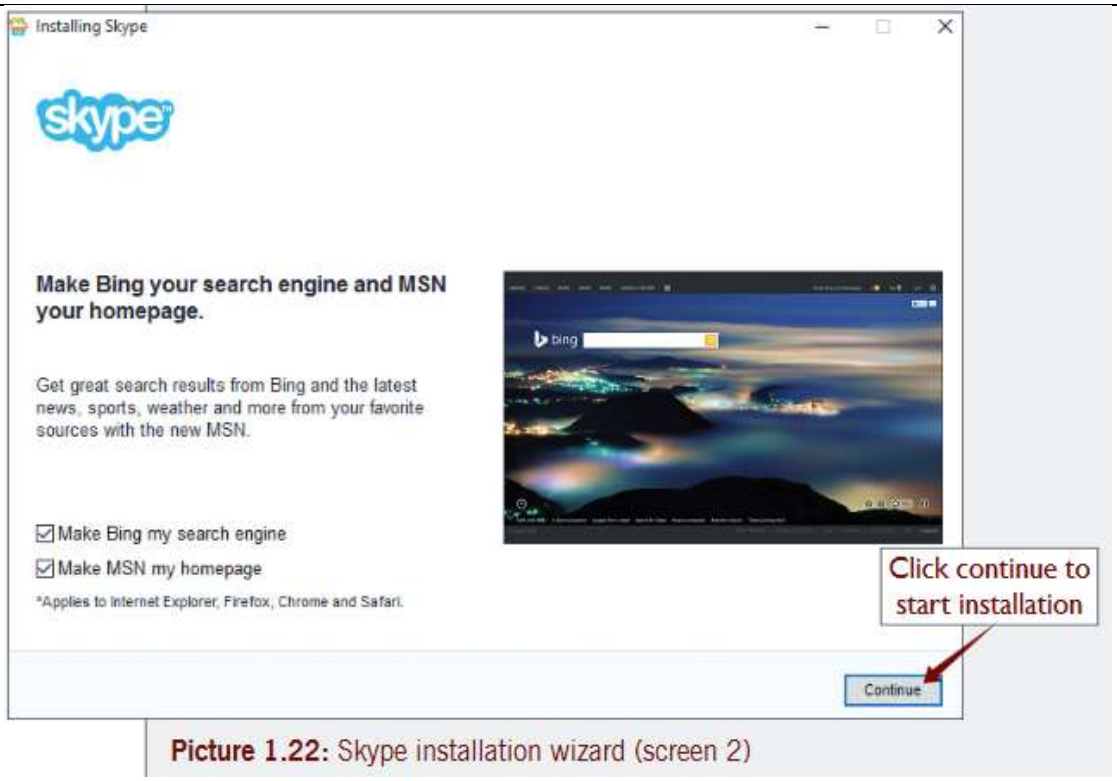
Step 2: Insert the disc in the disk drive.

Step 3: open the disc. Open the folder containing installation files.

Step 4: Double click on the setup file for skype to install. The wizard for installation starts as shown in picture 1.21.

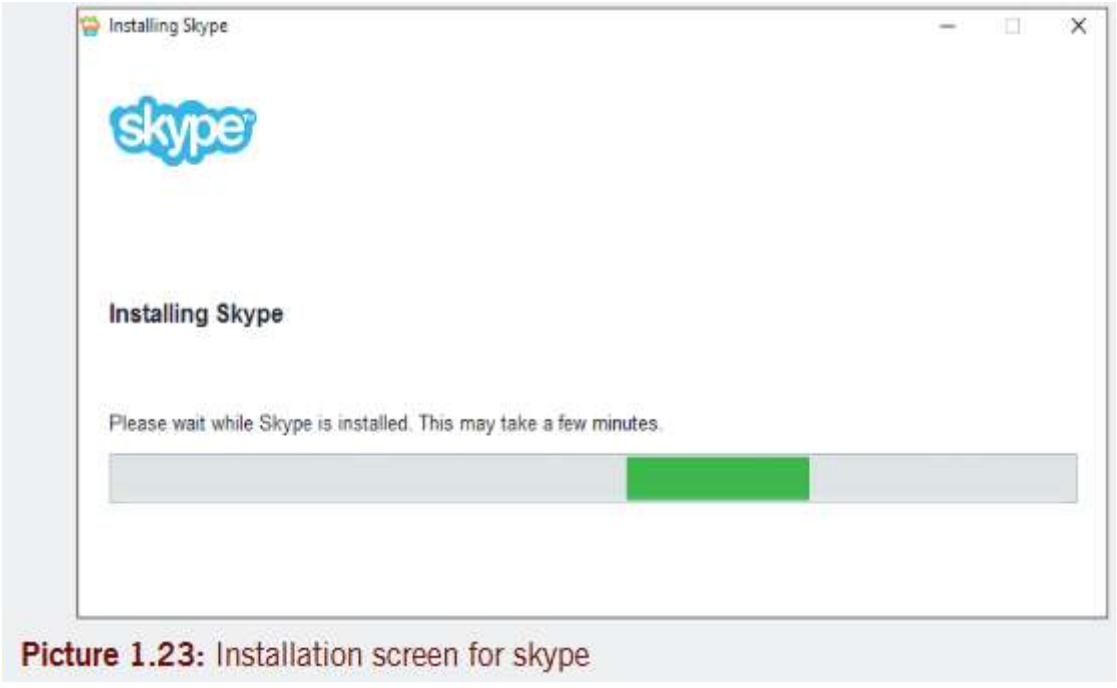


Picture 1.21: Skype installation wizard (screen 1)



Picture 1.22: Skype installation wizard (screen 2)

Note: Many Application programs require internet connections. So ensure Internet is available for proper and complete installation.



Picture 1.23: Installation screen for skype

you are using the latest version of Windows 10, skype is already installed on it. Just sign in with skype name, email or phone.

Step 5: Repeat step 4 above and install the rest of the software you downloaded that includes: Adobe Acrobat Reader, Chess game, Avast antivirus and nero burning software.

1.3 Install Antivirus

This is a utility program used for scanning computer viruses and removing them from the computer.

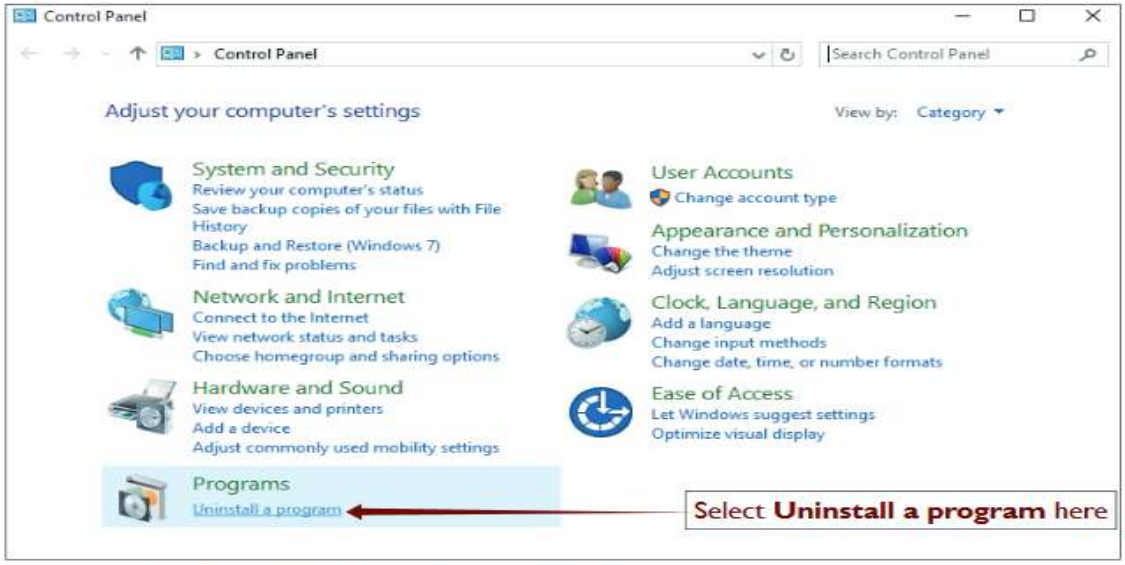
Viruses can corrupt computer data on hard disk, delete most important operating system files and can make the system to crash. Always install updated antivirus software and ensure you scan your system regularly with the program. You can download and install the antivirus you want depending on user experience or information from other users like norton, Kaspersky, AVG, McAfee, Avast, etc. similar steps are used to download and install different anti-viruses.

Uninstall application software

Take the following steps to uninstall (Google Chrome) an application software.

Step 1: Right click the start button and select Control Panel. (Or type "Control panel" in the search box at the start and press enter).

Step 2: In the control panel window that displays (as shown in picture 1.25) select Uninstall a program under Programs option.



Picture 1.25: The Control Panel window

Step 3: In the Programs and Features screen, select Google Chrome (you can select another program you are sure you do not need and uninstall it). Then click on Uninstall tab above programs list.

Step 4: Wait for the Windows Installer to gather all the features of (Google Chrome) program and remove them. Lastly close Control Panel.

Note: After uninstalling some applications such as MS Office, it requires to restart the computer to completely remove all the features. When you see a message prompting

you to restart, please accept it.

Software add-on

This is a piece of software that adds a specific feature or capability to an existing software application. A software add-on cannot be run independently, it is just a software extension.

Examples of common add-ons are *AdobeFlash, QuickTime and Silverlight.*

Role of add-ons

Interface change: the application can be dynamically extended to include new features which have friendly interface suitable for different users.

Adding features: More features are added to the browser (program) to increase its usability

Download and install add-ons

Using Mozilla Firefox Carryout a download to add various software extensions to your browser.

Step 1: Go to the Mozilla home page. You can use www.mozilla.org.

Step 2: Click Add-ons (First scroll down the page).

Step 3: on the new page that displays, go to the add-on or extension you want to add.

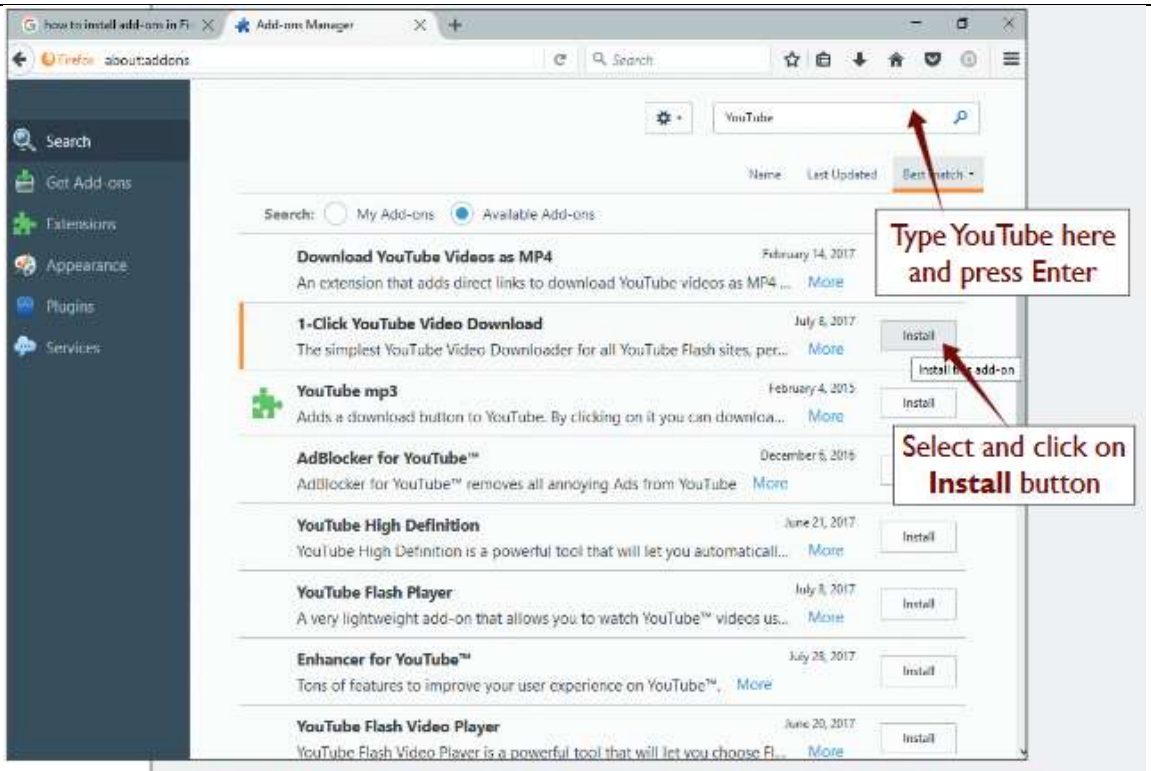
Step 4: Click the add-on you want to download. This automatically installs on your computer.

Download Helper

This is a tool used to extract videos and image files from websites and save them to your hard drive. As you are surfing the web Download Helper can detect that it can do something for you, the toolbar icon highlights and a menu allows you to download files by simply clicking an item.

Download file (Video) using add-ons/download helper

Step 5: In the new tab for Add-ons Manager, click in the search box at the upper right hand corner of the window. Type in the word YouTube and press enter key.



Picture 1.30: Firefox window displaying the Add-ons Manager tab active

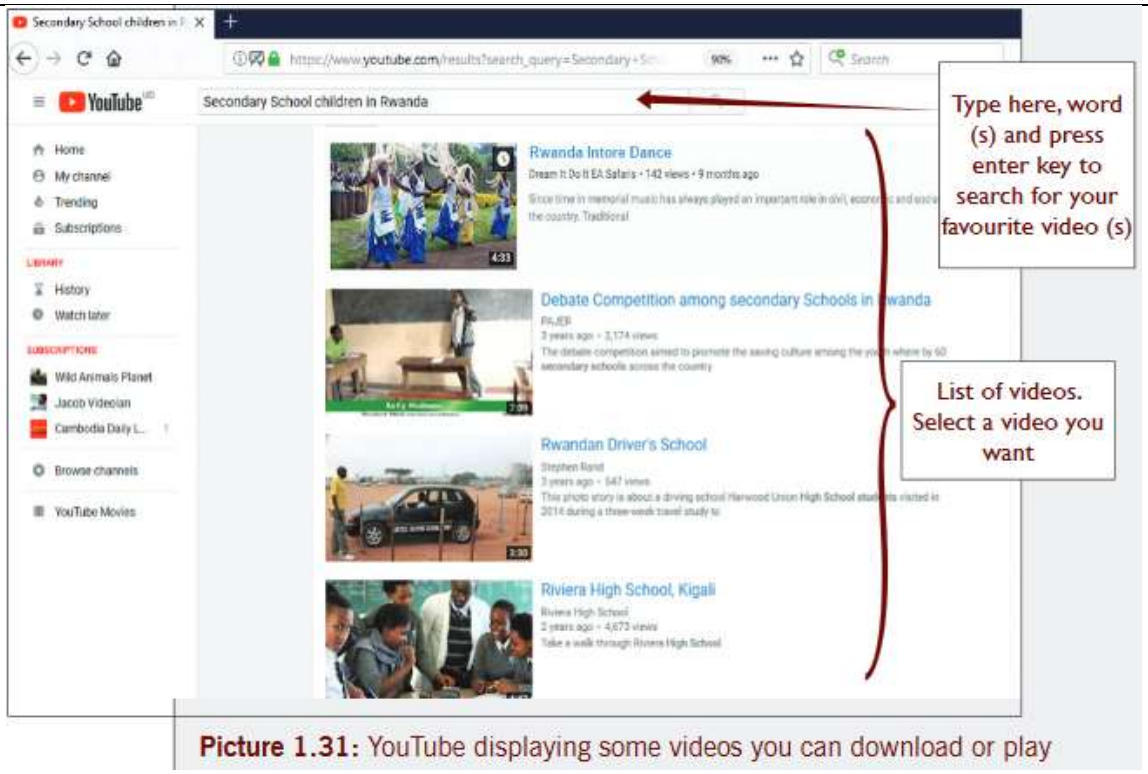
Step 6: Click the Install button next to the result "1-click YouTube Video Download".

Step 7: once the installation is complete, wait for a few seconds and then restart Firefox.

Step 8: type in the Address bar "**www.YouTube.com**". Locate your favourite video and click on it.

Step 9: If "I click You tube video download" is used, to download a video on You tube, there is a red button under Active Video download.

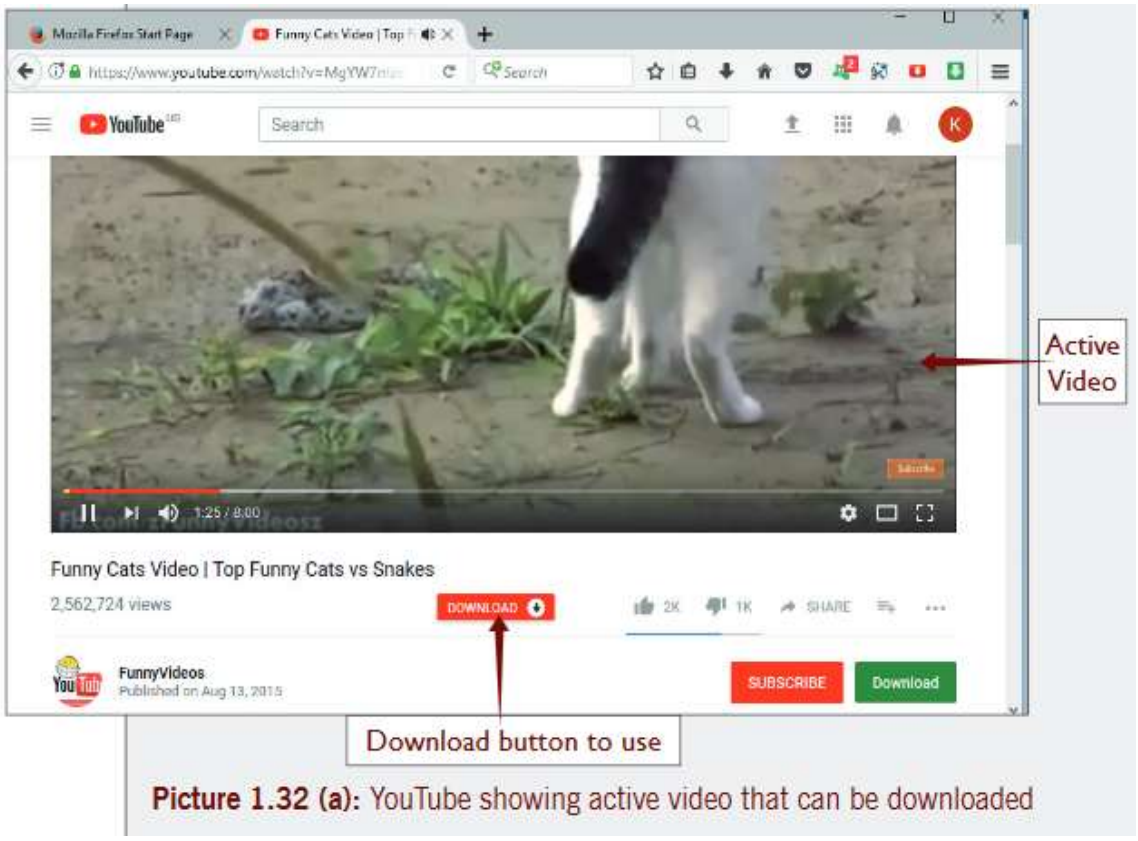
If Download Helper is used and there is an active video on any website, the icon is active to let you download it, see pictures 1.31 and 1.32.



Picture 1.31: YouTube displaying some videos you can download or play

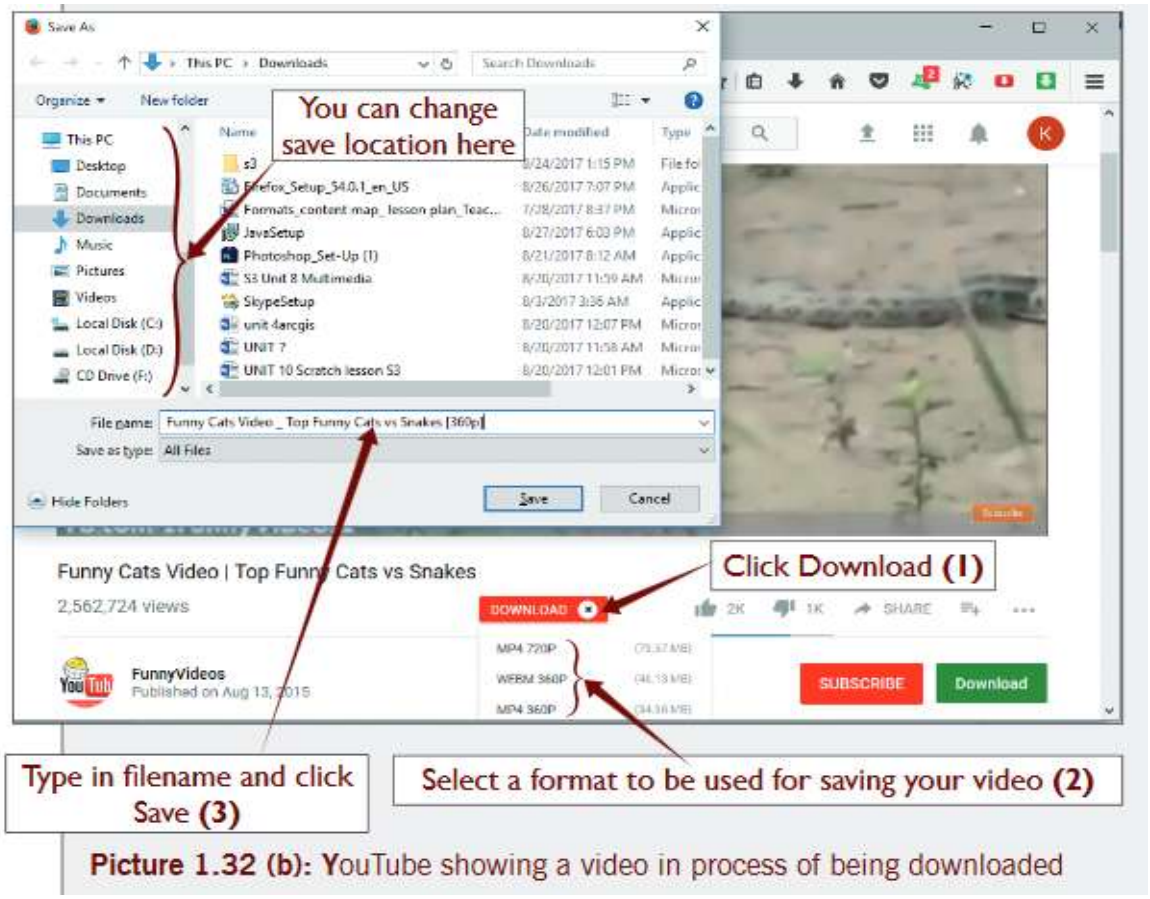
Copy the URL for your favourite video.

Step 11: From Save as dialog box, select location to save your video and click save continue to download the page.



Picture 1.32 (a): YouTube showing active video that can be downloaded

Click the Download button below the active video and the options it brings, select a suitable format. The save as dialog box displays.



Picture 1.32 (b): YouTube showing a video in process of being downloaded

Step 12: once the download is complete, watch the downloaded video at any time you want, using location specified.

Note: YouTube has been designed for users who only watch and view videos on their website. In case you want to download and save the video to your computer, you may have to select from a variety of online down loader programs or use YouTube down loader page to download the video.

Note: Ad blocker

This is software extension that reduces the number of unwanted, uncalled-for pop up ads which appear on the user's display in a browser. Ad is short for Advertisement. Pop up ads usually appear unexpectedly.

Ad block Plus is the most popular ad blocker for Firefox, opera, chrome, safari and internet explorer. It blocks banners, pop-ups, tracking and some malware.

Why should you remove ads?

There are many reasons why people choose to remove ads. some of the most frequent arguments are:

People do not want to be manipulated by online advertising.

Advertising is annoying in most cases.

Advertising often uses heavy graphics which slows the page loading.

Online advertising imposes a security risk for the Internet user, as the third-party banner ads may introduce security breaches to the site.

How to disable or remove browser plug-ins and add-ons

Internet explorer, Firefox, and Google Chrome each allow for the use of plug-ins and add-ons, which are scripts that supplement the functionality of the browser.

For - Mozilla Firefox

In the menu bar, select Tools > add-ons or click the Open menu button on the upper right page and select add-ons.

1. In the Add-ons Manager screen, find the add-on from the list of currently loaded add-ons on the right.

2. Select it and click on the Disable button at the bottom right. Windows users may also be able to uninstall add-on files through the Control panel.

Points to Remember

- **Application software installation** is the process of copying and configuring software files onto a computer system so that the software can be used.
- **Steps to install application software(Microsoft office)**

  1: Obtain Ms Office installation DVD (or download Installation file from the Internet.)

  2: Insert the disc in the optical drive (e.g. DVD Drive) the installation disc automatically launches setup wizard.

  3: Wait as office installs to complete the installation process.

  4: open an office application such as Word 2016.

  5: Afterwards office installs; click **close** after installation is complete.

6: If the activation wizard displays, click "*I want to activate the software over the Internet*" and then follow prompts.

Application of learning 4.3

You need to attend online class and you are supposed to use zoom application software to collaborate with colleagues in studying. How can you do installation of zoom app on a computer?

Learning outcome 4 end assessment

Theoretical assessment

SECTION A: Multiple Choice Questions

1. **What is the primary purpose of application software?**
   - A) To manage hardware resources
   - B) To perform specific tasks for the user
   - C) To provide an interface between the user and the hardware
   - D) To control system operations
2. **Which of the following is a prerequisite before installing application software?**
   - A) Ensuring sufficient storage space
   - B) Configuring BIOS settings
   - C) Installing the operating system
   - D) Updating the hardware drivers
3. **Which file extension typically indicates an installation package for Windows?**
   - A) .txt
   - B) .exe
   - C) .docx
   - D) .pdf
4. **Which of the following types of software requires installation?**
   - A) Web-based application
   - B) Portable application
   - C) Desktop application
   - D) Firmware
5. **What is the first step in the installation process of most application software?**
   - A) Running the installer file
   - B) Rebooting the system
   - C) Accepting the license agreement
   - D) Configuring application settings

Section B: Answer the following question by using True/False

1. Application software can be installed on a computer without an operating system.
2. During installation, some application software may require the user to select specific components to install.
3. All application software is compatible with every operating system. **(True/False)**
4. A system reboot is sometimes necessary to complete the installation of application software.
5. You must always uninstall older versions of an application before installing a new version.

SECTION C: Fill in the Blank Questions

1. Before installing new application software, it is important to check for _____ compatibility.
2. The _____ file typically guides the installation process of an application.
3. Installing application software without sufficient _____ space can lead to errors or incomplete installations.
4. After installing application software, a _____ may be required to finalize the process.
5. The _____ agreement must be accepted before the installation process can proceed.

Practical assessment

You are a computer science student tasked with setting up a development environment for your C++ programming projects. You need to install Dev-C++ on your Windows computer.

END

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